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CIVIL ENGINEERING.

The Mountain Top Track:—A Description of the Railroad across the Blue Ridge at Rock Fish Gap, in the State of Virginia. By CHARLES ELLET, Jr., Civ. Eng.

Mr. Charles Ellet, Jr., has always been distinguished among his professional brethren in this country, for the boldness of his engineering conceptions, and the assiduity and perseverance with which he devotes himself to the accomplishment of his projects. Enjoying the advantage also of regarding himself and his labors in the third person, (objectively as our German friends have it,) he has no hesitation in saying what he thinks of them, frankly and boldly, and as this is all necessarily in their favor, they are never wanting in at least one competent defender.

The pamphlet before us contains the account of the accomplishment of one of these schemes of Mr. Ellet, a project for the construction and regular working by locomotives of a railroad of steep gradients and abrupt curves, a project which seems to have met the opposition of some of the more timid of his professional brethren, while the simplicity of its principles, and apparent complete success, seem likely to condemn the originator to receive far less approbation than he really deserves for the successful introduction of such a novelty. Whether it is strictly true that "the difficulties overcome in the location and working of the line, very much exceed those which have made the Austrian road over the Sœmmering, famous throughout Europe," we cannot affirm, without better means of examination than are in our possession, and whether the achievement is to be set in history alongside of the conception and execution of the

road over the Simplon, posterity must decide, but it appears to us undeniable that it is at least deserving of being known out of the State of Virginia, and a knowledge of its success may, perhaps, encourage others in combating in other cases, the prejudices and misapprehensions which so frequently oppose improvement.

The Mountain Top Track is a part of a continuous line of railroad in course of construction through Central Virginia, from Richmond to the Ohio; and it appears that the Commonwealth of Virginia undertook the construction of 17 miles of this route, embracing the passage of the Blue Ridge, and the tunnel which was supposed necessary for this passage. As usual, the Commonwealth, like all other similar bodies, found it impossible to do what appeared so easy to be done, and finding, after four years' work on the tunnel, that at least three years more would be necessary for its completion, and that in the meantime, the Company of which he was the engineer, could not enjoy the revenue of the capital expended in the incomplete works, Mr. Ellet formed the bold design of crossing the Ridge by a temporary track to be worked by locomotive power, and intended to maintain a complete connexion of the roads at the eastern and western base. The description of this route, the degree of success which it has attained, and the means by which this has been secured, we extract from Mr. Ellet's pamphlet, congratulating him on an achievement, which must add still more reputation to that which he has heretofore earned. It may be as well also to note as a remembrance, that this idea of constructing a locomotive to work upon steep gradients, is, we believe, due to Mr. William Norris, of this city, and that the engines constructed by him in 1836, which frequently did service on the inclined plane at the Schuylkill, when the rope of the stationary engine was broken, were the first engines constructed which were capable of this kind of work.

Description of the Road.

The Mountain Top Track crosses the summit of the Blue Ridge at Rock Fish Gap, where the elevation of the mountain is 1885 feet above tide. The crest of the ridge is very narrow, and is passed on a curve of 300 feet radius.

There is barely room for an engine with an ordinary train to stand on the summit, before the road slopes off, descending both towards the east and west, to the valleys on either side of the ridge.

Western Side.—The length of the descent on the western side, from the summit to what is here assumed to be the foot of the mountain, is 10,650 feet, or $2\frac{3}{10}$ miles.

The track descends in this distance, on the west side, 450 feet—or, at the average rate of one foot in $23\frac{2}{3}$ feet.

The *average grade* on the western slope is, therefore, $223\frac{1}{10}$ feet per mile.

The *maximum grade* on the western slope is $5\frac{3}{10}$ feet in 100, or $279\frac{84}{100}$ feet per mile.

On both sides of the mountain the ruling curves are described with a radius of 300 feet, on which the grade is $237\frac{6}{10}$ feet per mile.

The excess of the maximum over the average grade is occasioned by

the attempt to compensate, in the distribution of the necessary ascent, for the effect of curvature. There was no experience to guide the writer in the arithmetical determination of the influence of such curvature as it was necessary to introduce upon this road, and the proper diminution of the slope required on the curves to compensate for the increased traction which would there be due to the curves. On this point professional information is still very deficient, even for curves of ordinary radii, traversed by engines of common construction propelled at the usual velocities of freight or passenger trains. For such an anomalous line as the writer was about to construct, there was absolutely no guide; and his allowance was therefore almost entirely conjectural.

When the road was first opened, it speedily appeared that the difference of 43 feet on the western side, and 58 feet on the eastern side, between the grades on curves of 300 feet radii and those on straight lines, was not sufficient to compensate for the increased traction due to such curvature. The velocity, with a constant supply of steam, was promptly retarded on passing from a straight line to a curve, and promptly accelerated again on passing from the curve to the straight line.

But, after a little experience in the working of the road, it was found advisable to supply a small amount of grease to the flanch of the engine by means of a sponge, saturated with oil, which, when needed, is kept in contact with the wheel by a spring. Since the use of the oil was introduced the difficulty of turning the curves has been so far diminished that it is no longer possible to determine whether grades of $237\frac{6}{10}$ feet per mile on curves of 300 feet radius, or grades of 296 feet per mile on straight lines, are traversed most rapidly by the engine.

Eastern Side.—But the more difficult portion of the work was on the eastern side of the mountain, where the ascent was greater, and the slope, in order to reach a certain level, which became a necessary condition of the problem of location, was required to be greater.

The length of the line of descent from the summit to the foot of the grade, is 12,500 feet, or $2\frac{37}{100}$ miles.

The road descends in this distance 610 feet, or at the average rate of one foot in $20\frac{1}{2}$ feet.

The *average grade* on the eastern slope is, therefore, $257\frac{4}{10}$ feet per mile.

The *maximum grade* on the eastern slope is $5\frac{6}{10}$ feet in 100, or $295\frac{68}{100}$ feet per mile.

This maximum grade is found in a continuous line of half a mile in length.

The shortest radius of curvature on this side of the mountain was intended to be 300 feet; but in the construction of the work a more abrupt curve was introduced at one difficult point, in order to throw the track further into the hill and keep the embankment off a face of sloping and treacherous rock. At this ravine, which is found about half way down the mountain, the radius of curvature is only 234 feet, and the grade upon that curve is $237\frac{6}{10}$ feet per mile.

The total length of the track from the foot of the mountain on the west side, across the summit, to the foot of the mountain on the east side, is

$4\frac{33}{100}$ miles. But, in consequence of delays which occurred in the construction of other parts of the Commonwealth's road, it became necessary to extend the track 3½ miles further, running it around unfinished cuts and embankments at four different points, so that the distance actually worked by the mountain engines is about *eight miles.*

The Locomotive Engines used.

This road was opened to the public in the spring of 1854, and it has now, in the autumn of 1856, been in constant use for a period of more than 2½ years. In all that time the admirable engines relied on to perform the extraordinary duties imposed upon them in the passage of this summit, have failed *but once* to make their regular trips. The mountain has been covered with deep snows for weeks in succession, and the cuts have been frequently filled for long periods many feet in depth with drifted snow: the ground has been covered with sleet and ice, and every impediment due to bad weather and inclement seasons has been encountered and successfully surmounted in working the track.

During the last severe winter, when the travel upon all the railways of Virginia and the Northern and Western States was interrupted, and, on many lines, for days in succession, the engines upon this mountain track, with the exception of the single day already specified, moved regularly forward and did their appointed work. In fact, during the space of 2½ years that the road has been in use, they have only failed to take the mail through in this single instance, when the train was caught in a snow drift near the summit of the mountain.

These results are due, in a great degree, certainly, to the admirable adaptation of the engines employed to the service to be performed; but they are due, also, in no small degree, to the skill and energy of the superintendent in immediate charge of the track and machinery.

The locomotives mainly relied on for this severe duty were designed and constructed by the firm of M. W. Baldwin and Company of Philadelphia. The slight modifications introduced at the instance of the writer to adapt them better to the particular service to be performed in crossing the Blue Ridge, did not touch the working proportions or principle of the engines, the merits of which are due to the patentee, M. W. Baldwin, Esq.

These engines are mounted on six wheels, all of which are drivers, and coupled, and 42 inches in diameter. The wheels are set very close, so that the distance between the extreme points of contact of the wheels and the rail, of the front and rear drivers, is 9 feet 4 inches. This closeness of the wheels, of course, greatly reduces the difficulty of turning the short curves of the road.

The diameter of the cylinders is 16½ inches; and the length of the stroke 20 inches.

To increase the adhesion, and at the same time avoid the resistance of a tender, the engine carries its tank upon the boiler, and the footboard is lengthened out and provided with suspended side boxes, where a supply of fuel may be stored. By this means the weight of wood and water, instead of abstracting from the effective power of the engine, contributes to its adhesion and consequent ability to climb the mountain.

The total weight of these engines is 55,000 pounds, or 27½ tons, when the boiler and tank are supplied with water and fuel enough for a trip of eight miles is on board.

The capacity of the tank is sufficient to hold 100 cubic feet of water, and it has storage room on top for 100 cubic feet of wood, in addition to what may be carried in the side boxes and on the footboard.

To enable the engines better to adapt themselves to the flexures of the road, the front and middle pair of drivers are held in position by wrought iron beams, having cylindrical boxes in each end for the journal bearings, which beams vibrate on spherical pins fixed in the frame of the engine on each side and resting on the centres of the beams. The object of this arrangement is to form a truck, somewhat flexible, which enables the drivers more readily to traverse the curves of the road.

There were three engines constructed expressly for this track, of which two answer to the description here given. The third engine was built by Mr. Joseph R. Anderson, of Richmond, and is an excellent machine and capable of doing good service. Resting on eight wheels, and being more rigid than the others, it does not yield so easily to the very short curves of this track. It is therefore kept on hand as a reserve engine, and is frequently employed to relieve the regular engines of the road.

Duties and Speed of the Engines.—The writer has never permitted the power of the engines on this mountain road to be fully tested. The object has been to work the line regularly, economically, and, above all, *safely;* and these conditions are incompatible with experimental loads subjecting the machinery to severe strains. The regular daily service of each of the engines is to make four trips, of eight miles, over the mountain, drawing one eight-wheel baggage car, together with two eight-wheel passenger cars, in each direction.

In conveying freight, the regular train on the mountain is three of the eight-wheel house cars fully loaded, or four of them when empty or partly loaded.

These three cars, when full, weigh with their loads from 40 to 43 tons. Sometimes, though rarely, when the business has been unusually heavy, the loads have exceeded 50 tons.

With such trains the engines are stopped on the track, ascending or descending, and are started again, on the steepest grades, at the discretion of the engineer.

Water, for the supply of the engines, has been found difficult to obtain on the mountain; and since the road was constructed a tank has been established on the eastern slope, where the ascending engines stop daily on a grade of 280 feet per mile, and are there held by the brakes while the tank is being filled, and started again at the signal and without any difficulty.

The ordinary speed of the engines, when loaded, is 7½ miles an hour on the ascending grades, and from 5½ to 6 miles an hour on the descent.

Greater speed and larger loads might doubtless be permitted with success; but the policy has been to work the track with perfect safety, to risk nothing, and to obtain and hold the public confidence.

Brakes, Couplings, &c.—In recommending the use of this anomalous track for the conveyance of passengers, the writer felt severely the great responsibility of his position. No care that his judgment and foresight could provide was neglected to secure the most perfect safety to those whose lives were entrusted in the hands of the Company and its agents.

The rule was adopted that no car should be suffered to cross the mountain that did not possess a brake for every wheel, of power sufficient to clutch the wheel firmly and prevent its rotation. All fixtures by which the brakes might be acted upon by the engineer, and the power conveyed simultaneously to all the wheels through a common bar or chain, were rejected, because the giving way of this connecting bar would render all the brakes which were made dependent upon it powerless.

The brakes were required to be inspected at every trip by an experienced man, and to be in perfect order for service before the mountain engine could be attached to the train.

The giving away of a coupling was another source of danger to be guarded against upon such grades; for, if the brakemen on the ascending train should be neglectful, and fail to apply their brakes when a coupling bar or bolt should break, the disengaged car might be carried down the grade.

To guard against this danger, reliable couplings were provided for all the cars; and, for further security against the possibility of such an accident, two powerful tug chains were attached as extra couplings between the locomotive and the forward car, and also between each two separate cars, which are reserved couplings, coming into service only in case the regular coupling bar or its connexions should part. These guard chains are always attached as soon as the mountain engines, or "climbers," as they are called, are put on.

When the track is in good condition, the brakes of only two of the cars possess sufficient power to control and regulate the movement of the train—that is to say, they will hold back the two cars and the engine. When there are three or more cars in the train, the brakes on the cars, of course, command the train so much the more easily.

But the safety of the train is not dependent on the brakes of the cars. There is also a valve or air-cock in the steam chest, under the control of the engineer. This air-cock forms an independent brake, exclusively at the command of the engineer, and which can always be applied when the engine itself is in working order. The action of this power may be made ever so gradual, either slightly relieving the duty of the brakes on the cars, or bringing into play the entire power of the engine.

The train is thus held in complete command. Yet no precaution is neglected to have all parts of the machinery always in effective condition —brakes, each and all—in perfect order, every man at his post, and a competent and vigilant superintendent over them to enforce discipline and command the train.

A supply of sand is not neglected; for, though the brakes completely control the train in ordinary weather, yet, when the cold is intense, and the track, wheels, and brakes are all covered with snow, frozen into hard

ice, they will not hold. Then, as usual, sand is applied in the front of the forward drivers or in front of the middle drivers, as is, under the circumstances, most expedient; and the friction may be increased to whatever amount is necessary for the safety of the train.

With the passenger trains, there is a man at the brake on every platform, who never leaves his post while on the mountain, whether the train be ascending or descending. For the freight trains, four brakemen are required to attend to the brakes of three cars, or five brakemen to those of four cars.

Such tracks as this over the Blue Ridge are very dangerous under negligent or unskilful management. But with care to observe the rules prescribed, and to keep within the authorized loads and speed, they are quite as safe as, if they are not safer than, ordinary railways worked with ordinary care.

Current Expenses of this Track.

The current expenses of maintaining and working this track are scarcely as great as might be expected from its anomalous and difficult character.

The ordinary consumption of fuel by one of the mountain engines, ascending the eastern slope of the mountain, from the foot of Robinson's Hollow to the summit—a distance of $2\frac{62}{100}$ miles—in which an elevation of 660 feet is overcome, and many curves of 300 feet radius are turned, is 42 cubic feet, or very nearly one-third of a cord. The total weight of the engine and train, or mass moved, is 70 tons.

The cost of fuel is there $2·00 a cord.

The fuel used in traversing the whole length of the track, from the Greenwood Station to the western base of the mountain, a distance of 8 miles, including both the ascent and descent of the mountain, is two-thirds of a cord, costing $1·33, exclusive of the cost of firing up.

The total cost of working the two engines when making two round trips each per diem, is as follows:—

2 Engineers, at	$75	each	per	month,			$ 150·00
6 Brakemen, "	20	"	"				120·00
2 " "	25	"	"				50·00
2 Firemen, "	25	"	"				50·00
2 " "	17·50	"	"				35·00
1 Machinist, "	75	"	"				75·00
Wages of engine and train hands, per month,							$ 480·00
Fuel, oil, &c., for two engines, per month, when making each four trips a day,							350·00
							$830·00

Annual locomotive expenses, $9960.

Maintenance of the Road.

Salary of Superintendent, per annum,	$ 1,200·00
2 Section Masters, each $400,	800·00
12 Laborers (negroes), at $ 150 per annum,	1800·00
1 Laborer at wood station,	150·00
Amount carried forward,	$ 3950·00

Amount brought forward, . .	$3950·00
2 Watchmen at trestles, $ 240, . .	480·00
1 Night Watch at terminus, . .	365·00
Annual Cost of Superintendence and Maintenance,	4795·00
Add Locomotive expenses, . .	9960·00
Cost of Maintaining and Working, . .	$ 14,755·00
or, per mile per annum, $1845.	

To this total must be added, of course, the cost of repairing the locomotive engines and cars; and also the depreciation, properly due to this track, of the cars and engines and the track itself.

The engines, when delivered to the Company, were all exceedingly substantial, and have needed but small current repairs beyond what the machinist of the track has been able to give to them and to the cars. No separate account has been or could be kept of the other repairs of the cars—the track being worked in connexion with the road east and west of the mountain.

Depreciation is always a very important item of railroad charges; but, while the machinery and track are comparatively new, any estimate of that item which might be here offered would be altogether speculative—while the object of this paper is to present only ascertained and reliable facts.

The writer does not wish to close this brief description of a road, which, though built for a temporary purpose only, he thinks is likely to exercise a material influence on many future works, without duly acknowledging his obligation to those gentlemen whose co-operation materially aided in the rapid progress and great success of the work.

To his principal assistant, Thomas S. Isaac, he is indebted for the skilful and accurate executions of his plans:

To C. R. Mason and Wm. S. Carter, contractors, for their great energy and obliging promptitude in providing and applying their forces wherever needed to press forward the work:

To Messrs. M. W. Baldwin & Co., of Philadelphia, for the excellent engines that work the road: and, finally,

To George S. Netherland, superintendent of this track and machinery, for his prudence, carefulness and indefatigable and intelligent personal attention to the maintenance of the way and the management of the transportation across the mountain.

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*On the Geology and Physical Geography of North America.** By Prof. Henry D. Rogers, from the United States.

The speaker stated that his object in this discourse was to present a condensed view of the physical features and geological outlines of North America,—a country highly interesting, from the majestic scale of its natural structure—from its peculiar position on the earth's surface, lying intermediate between Europe on the one hand, and Asia and Australia on the other—as a half-way house to connect the commerce and civili-

* Notices of the Meetings of the Royal Institution of Great Britain, Feb. 8th, 1856.

zation of the world; and tenanted by an energetic people, essentially a composite nation, made up of the enterprising and ardent spirits who have gone from the various more civilized countries of Europe.

Taking a comprehensive but rapid survey of the general physical features of North America, we find it presents but two great slopes, one sinking towards the Atlantic, the other towards the Pacific, divided by a lofty mountain axis, the Chippewayan or Rocky Mountain chain, the true water-shed or backbone of the continent.

From either base of this chain, where the plane of the country has an elevation of 5000 to 6000 feet above the sea, the continent slopes eastward and westward, interrupted by only two important intervening mountain swells—the Atlantic or Appalachian chain, and the Pacific or Californian. These oceanic chains only partially turn the drainage; some of the largest rivers, the Susquehanna and Kanawha, in the one case, Frazer's River and the Great Columbia in the other, cutting quite through them. Another broad swell of the surface crosses the continent, nearly westward, from Labrador to the sources of the Columbia, passing between the Lawrentian Lakes and Hudson's Bay, and between the sources of the Missouri and those of the Saskatchawan. From this the continent slopes gently northwards, to its Arctic shores, and southwards, to its Mexican. All these slopes are well indicated in the river drainage.

Looking closer, there appear seven grand primary divisions of the surface of the continent, comprising two broad continental plains, three great belts of mountains, and two narrow oceanic slopes.

A.—The largest of these areas is the Great Central Plain, extending from the Gulf of Mexico to the Arctic Sea and Hudson's Bay, and from the Appalachians to the Rocky Mountains, a wide continental region of table-lands, plains, and gentle slopes.

It consists of two physically different districts—the one a western region of elevated table-lands or steppes; the other, a parallel eastern zone of less average elevation, comprising three great basins or plains, of river and lacustrine drainage.

I. *The Western Steppes.*—These constitute a wide zone, east of the Rocky Mountains, about 350 miles broad, ranging from the 28th to beyond the 60th degree of latitude; including, indeed, the Arctic Highlands, east of Mackenzie River. From the Arkansas to the Upper Missouri this plateau has a mean level above the sea of about 4000 feet, rising, at the base of the mountains, to 5000, and at the highest east and west swell of the surface, to 6000 feet. The general eastern boundary of this great terrace, which has a mean height of about 2000 feet, follows approximately the meridian of 98° W.; but northward of the Nebraska and Missouri, it is not so well defined. Rising to the foot of the Rocky Mountains, by successive steps and gentle slopes, the plain contains one escarpment, which being much more conspicuous than the rest, seems to divide it into two belts. This, which coincides with the meridian of 101° W., is best marked between lat. 32° and the Arkansas, but extends to the Forks of the Nebraska, and yet further. From the Pecos to the Nebraska, the upper plateau is about 3500 feet above the sea, and is 1000 feet higher than the table-land east of it. This entire

western belt, as far north as the Missouri, is a barren and thirsty treeless desert, especially in its southern half. It is without verdure, except along the very attenuated streams, and at certain seasons is entirely rainless. North of the Missouri it is better irrigated, and more grassy, and includes many rivers and lakes.

The lower terrace resembles the upper in its flat monotonous surface, its treeless wastes, and arid summer climates, but it is rather more grassy, and its southern streams are better fringed with trees and verdure. All the rivers, from the Pecos to the Arkansas, issue from the upper table land to the lower, through deep narrow sluices (cañons), between precipices of enormous height. For more than 400 miles, from the Brazos to the Arkansas, the lower treeless plain is fringed by a remarkable belt of woodland, from 5 to 25 miles wide, which is called the "Cross Timbers." This strip of forest forms the western boundary of the fertile and better watered still lower plain of Texas, a region of verdant prairies, dotted with natural parks, and clumps of live oaks and other noble trees.

II. *The Eastern Basins.*—This vast tract, embraced between the northwest base of the Appalachian mountains and the eastern border of the elevated western plateau, is a broad well-watered plain, full of streams and lakes, rising nowhere higher than 1500 feet above the sea; and in few districts higher than 500 to 700 feet. It includes three large natural basins of drainage—that of the Mississippi, and its affluents east of the high western steppes; that of the Lawrentain Lakes and their feeders: and that of the southern, western, and eastern tributaries of Hudson Bay.

1. *The Mississippi Basin.*—This wide river basin slopes so gently southward that its height at the mouth of the Missouri, nearly 700 miles from the sea, is only 388 feet; and at the Falls of St. Anthony, 1150 miles from the sea, it is no more than 856 feet. Its eastern and western slopes are likewise extremely gentle, as shown by the fact, that the elevation of the plain at Pittsburgh, nearly 600 miles from this Mississippi, eastward, is only 679 feet; and in the opposite direction, at the mouth of the republican fork of the Kansas, it is still but 927 feet. The basin of the Mississippi and Missouri is divided from that of Hudson Bay,—from the western end of Lake Superior to the foot of the Rocky Mountains, but eastward from the drainage of the Lawrentian Lakes, by a low water-shed, nowhere higher than 1300 feet, and in few districts more than 1000 feet above the sea. This whole Mississippi plain enjoys a soil and climate of rare fertility, and possessing enormous coal-fields and other mineral wealth, is endowed with extraordinary agricultural, commercial, and manufacturing resources. From the western slopes of the Appalachians to the Mississippi, the Wabash, and Lake Michigan, nearly the entire surface was originally clothed with forest; but west of those limits, the vast plain consists of gently rolling verdant prairies, intersected by strips of woodland along the valleys of the streams; and on the south-west, sprinkled with parks, and scattered clumps of trees.

2. *The Lawrentian Lake Basin.*—This middle basin, from the head of Lake Superior to Lake Ontario and the Ottawa, is separated on its south from the basin of the Mississippi and Ohio, by the low water-shed

bordering its lakes; and on the north, from the southern feeders of Hudson Bay, by a somewhat higher water-shed, ranging from Missabay Heights, where the summit tract is about 1500 feet high, north of Lake Superior and the Ottawa, and gradually declining to the sources of the Saguenay. It is a curious feature of this basin, that its western rim is only 50 miles west of the head of Lake Superior, the southern and northern water-sheds which embrace it, uniting in about long. 92° 50′. An unusual portion of the surface of this basin is covered with water. Its five great lakes contrast their magnitude with the smallness of the area which supplies them; for both the water-sheds are in relatively close proximity to these basins. In some districts the southern water-shed is only a few miles distant from Lakes Michigan and Erie; while some of the streams descending southward are more than 2000 miles from the Gulf of Mexico. But this anomaly vanishes, when we recognise in these lakes only expansions of the Upper St. Lawrence, their southern water-shed then taking its true half-way position below the Gulf of St Lawrence and the Gulf of Mexico. The basin of the five lakes is a wide level plateau falling eastward, by successive stages, from a level at the surface of Lake Superior of 628 feet, to one of 232 feet at the surface of Lake Ontario. Its confining water-sheds are only the eastern extensions of the great central swell of the Continent, forking where it approaches Lake Superior; one branch ranging northward, the other southward, of this long and narrow basin.

3. *The Hudson Bay Basin.*—This almost rivals in size that of the Mississippi. It is separated from that of the St. Lawrence by a low crescent-shaped, curving water-shed, beginning in the highlands of Labrador and the Watchish Mountains, and extending westward to the Missabay Heights. To the south-west and west, its boundary is the vaguely-traced limit of the western plateau, prolonged north-north-west, from the Missouri towards Lake Athabaska. This great basin is a region of innumerable tortuous streams and inosculating lakes and swamps, converging their drainage into Hudson Bay. In the northern half of the continent, the larger rivers which enter Hudson Bay, as the great Saskatchawan, descend from the base of the Rocky Mountains, across the low water-shed, which forms the western rim of this basin; thus linking it hydrographically with the high western plateau, and establishing in a wider sense, one great hydrographic basin from the Watchish to the Rocky Mountains, north of the east and west swell of the continent. The general elevation of the extensive rim of the Hudson Bay Basin, is scarcely anywhere higher than 1600 feet above the sea; the average level of the whole girdle probably not exceeding 1000 feet. It is a cold, inhospitable, and snowy district, its rocks deeply overlaid with sterile drift, and its surface extensively covered with a net-work of waters and wet swamps.

B. The Appalachian Mountain Zone.

This Atlantic mountain range embraces the whole belt of mountain ranges, extending from the Gulf of St. Lawrence at Gaspé, to Georgia and Northern Alabama. It consists of two divisions—a north-eastern, ranging from Gaspé to the valley of the Hudson; and a south-western,

thence to the interior of Alabama: the total length of the chain is about 1500 miles, while its breadth varies from 150 to 200 miles. In the chief divisions of its length it is a wide complex belt of many parallel ridges, whose crests nowhere ascend much beyond 4000 feet above the sea; the base of the chain, where highest, being about 1800 feet above the sea level. From Alabama to the Hudson, the Appalachian chain is the water-shed between the Atlantic rivers and those of the Ohio and Lake Ontario; and from the Hudson to the Gulf of St. Lawrence it separates the drainage of those flowing to the Atlantic from the shorter streams entering the St. Lawrence. The Hudson valley does not entirely separate this long, nearly continuous mountain system. A depression of the continent to a depth of only 300 feet, would let the ocean through from the Gulf of St. Lawrence to the Bay of New York, and interpose a strait, nearly as broad as that between England and the European continent, between the main land of North America, and the even now half insulated districts of New England, New Brunswick, and Nova Scotia. That this great transverse depression of the surface, now uniting the estuaries of the St. Lawrence and the Hudson, was once thus actually submerged, is proved by indisputable geological monuments, consisting of oceanic clays containing marine pleistocene tertiary fossils.

The *North-eastern* section of the Appalachians contains as its principal chain the Green Mountains, a long belt of parallel and swelling ridges commencing in the Nôtre Dame range, south of the St. Lawrence, in Lower Canada, and terminating at the Schuylkill River, in Pennsylvania. These mountains at the Hudson, under the name of the Highlands, are cut to their base by that tidal river. In Vermont their rounded summits are 4000 feet high, but on the Hudson they nowhere exceed 1600 feet. The White Mountains of New Hampshire, and the Adirondac group in the north-east corner of New York, are lofty, outlaying masses, subsidiary to the Appalachians. They consist chiefly of the crystalline rocks. Their highest peaks exceed 5000 feet, and that of Mount Washington, the loftiest east of the Rocky Mountains, is 6428 feet above the sea level.

South-western Appalachians.—From the Hudson and Mohawk to middle Alabama, extends the other great division of the Appalachian chain, marked by an extraordinary parallelism, length, narrowness, steepness, and evenness of its numerous ridges. Its south-eastern belt, the most undulating and picturesque, is the Blue Ridge of Virginia, and the Smoky or Unaka Mountain range of Carolinas, Georgia, and Tennessee; it is nearly identical in geological structure with the Green Mountains, and resembles them in contour and scenery. Its highest crests, which are in North Carolina and Tennessee, reach to 4000 and 5000 feet above the sea. The rocks of the Blue Ridge and Green Mountain chains, are chiefly ancient metamorphic strata, as gneiss, talcoze, and chloritic schists and highly altered argillaceous and sandy strata low in the palæozoic system, including, indeed, some of the oldest fossiliferous formations: these stratified masses are penetrated by igneous veins and dykes.

To the north-west of the Blue Ridge, and separated from it by a long continuous plain, called the Great Appalachian Valley, runs a parallel range of the middle Appalachian belt, traceable from the St. Lawrence

to Alabama. This central zone of mountains consists of long narrow level ridges, divided by narrow longitudinal valleys, and cut to their bases by sharp deep ravines permitting the passage of the rivers. These ridges, caused by excessive erosion of the parallel waves of the strata, of which the central Appalachians consist, are linked into groups of several parallel crests, some of them remarkably straight for great distances, others gently curving. In many instances two narrow mountain crests unite at the two extremities to enclose a deep trough-shaped valley; some of these valleys, with their mountain borders, having a remarkable resemblance to a long narrow canoe or skiff. One class have a synclinal structure, the highest strata being in the bed or centre of the valley, and the hard lower rocks forming the enclosing parallel mountain crest. The other class are anticlinal in their form, a powerful erosive action of waters having carved them out by cutting through the crests of the original crust-waves, and scooping down to the softer lower strata. In some portions of this middle belt the long narrow ridges unite in wider mountain table lands of the general height of the chain.

The rocks of this long middle Appalachian belt are exclusively palæozoic strata, comprising all from the base of that system to the upper coal measures inclusive. Scarcely a single igneous dyke or mineral vein intrudes itself into this, or the next more western division of the Appalachians.

The north-western belt of the Appalachians is a long and comparatively high table land, called the Alleghany Mountain in Pennsylvania, the Sewell Mountain in Virginia, and the Cumberland Mountain in Tennessee. Almost the whole way continuously from north-eastern Pennsylvania to northern Alabama, it presents a high escarped slope, facing south-eastward toward the middle chain. This table land is composed of nearly horizontal strata of the upper Devonian formations at its base, and of carboniferous rocks in its higher parts, wide tracts of it being covered exclusively by bituminous coal measures. Along its south-eastern border it is gently undulated with parallel broad regular anticlinal and synclinal flexures of the strata, the expiring waves of the middle Appalachian belt, where these crests are stronger, steeper, and more crowded. The plateau subsides to the north-west with the dying out of these flexures, and sinks into the broad plain of the basins of the Ohio and Mississippi.

A longitudinal survey of the Appalachian chain shows much undulation in its direction, and discovers ten distinct sections as respects its trend. Five of these are straight, three of them convex towards the north-west, and two of them convex towards the south-east.

C. The Rocky Mountains, or Chippewayan Chain.

This very elevated mountain axis, or main water-shed of the continent, consists generally of two, but in some districts of three, principal ranges, each composed of many high mountain crests, deep valleys, and elevated table lands. The great component ranges are approximately parallel, but they are variously linked and inosculated by transverse ridges. Their crest lines undulate on a stupendous scale, and many of their summits are sharply notched and serrated like the Alps. The main

eastern range rises like a huge rampart above the great table land at its base, presenting a deeply gashed flank and vast mountain buttresses towards the plain. Longitudinally the whole chain consists of many sections broken by deep passes, and by the cessation of the leading ridges, which, in many instances, do not join, but lap past each other. This recently ascertained feature presents unexpected facilities for the construction of railways, and other avenues of communication across the continent. In Northern Mexico the eastern range is the Cordillera of Cohahuela and Potozi, the Guadaloupe Mountains being only an outlaying chain of ridges; and the western range is the Sierra de los Mimbres. Opposite the sources of the Arkansas, the eastern belt is the Moro and Chowatche, or Wet Mountain; and the western the San Juan and La Plata Mountains. The Noble valley of the Rio del Norte is here embraced between the two ranges. From the Arkansas to the north fork of the Platte, the chain is more complex and triple; its eastern range, comprising the Medicine Mountain, contains some of the loftiest peaks of the Rocky Mountains: such are the Spanish Peaks, Pike's, Long's, and Laramie's Peaks, all rising to 10,000 and 12,000 feet above the sea. North of the Platte rise the Wind River Mountains, the loftiest division of the chain. Here Fremont's Peak has an elevation of 13,568 feet. This high mountain axis is the focal water-shed of the continent, for it parts the head fountains of the Missouri flowing to the Atlantic, from those of the Columbia and Rio Colorado, descending westward to the Pacific.

Branching southward from the Rocky Mountains, near the Wind River range, is the long and lofty chain called the Wahsatch. It is the eastern boundary of the Great Utah Desert, and the western barrier of the basin of the Rio Colorado, the Rocky Mountains being the eastern. Northward of the Wind River chain the eastern, or main axis of the Rocky Mountains, is exceedingly high, where it divides the middle and northern streams of the Columbia from the sources of the Missouri and Saskatchawan. Near the head of the latter great river, Mount Hooker towers to the height of 15,700 feet above the sea; and a little further north, Mount Brown, the feeder of the river Athabasca, reaches the yet greater altitude of 15,990 feet. From this culminating district the chain gradually declines northward to the Arctic Ocean. Beyond lat. 55° the main eastern crest ceases to be the water-shed between the Pacific and Hudson Bay, or the Arctic Ocean.

The geological constitution and structure of the Rocky Mountains are very imperfectly known. Granite and gneissic rocks, and various palæozoic strata, including much carboniferous limestone, have, however, been extensively noticed in many districts. Between the higher ridges occur table lands and valleys, consisting apparently of cretaceous and tertiary deposits.

(To be Continued.)

For the Journal of the Franklin Institute.

Helices and Helicoidal Surfaces. By JOHN M. RICHARDSON, B. S.

A helix is a line which makes a constant angle with the horizon, and is generated by a point which moves so that the ratio of its ascent to the horizontal projection of the path described is constant.

A helicoidal surface consists of a series of helices in juxtaposition, and is generated by a line which moves so that each of its points describes a helix.

Let z = length of helix;
s = " horizontal projection;
y = ordinate of helix;
a = constant angle of helix; then

$$dz \cos a = ds\,;\ dz \sin a = dy \qquad (1)$$

Integrating,

$$z \cos a = s\,;\ z \sin a = y \qquad (2)$$

Squaring equations (2), and adding them,

$$z^2 = s^2 + y^2 \qquad (3)$$

Dividing the first of (2) by the second,

$$s\,y^{-1} = \cot a \qquad (4)$$

Equations (2,) (3,) and (4,) are well known trigonometrical formulas, and prove that the relations between any portion of a helix, its projection, and the difference between its extreme ordinates are the same as the relations between the hypothenuse and legs of a right-triangle.

The relations established above, are perfectly true, whatever may be the nature of the surface upon which the helix is located.

If z, or y, or s be given—a being known—the other two are easily determined.

To complete the determination of the helix, the equation of its horizontal projection must be ascertained.

Let ρ = radius vector estimated from an assumed centre.
ϕ = angle made by ρ with directrix passing through initial point of projection;

Then,

$$s = \int (d\rho^2 + \rho^2 d\phi^2)^{\frac{1}{2}} = \mathrm{F}\,\phi \qquad (5)$$

But

$$s = \mathrm{F}'\,\rho \qquad (6)$$

Hence,

$$\mathrm{F}'\,\rho = \mathrm{F}\,\phi \qquad (7)$$

(7) is the equation of the projection.

If the generatrix in its initial position be supposed to have an ordinate c, equations (2,) (3,) and (4,) will become

$$\left.\begin{array}{l} z \cos a = s\,;\ z \sin a = y - c\,; \\ z^2 = s^2 + (y-c)^2;\ s\,(y-c)^{-1} = \cot a \end{array}\right\} \qquad (A)$$

The equation of a helicoidal surface is the same as that of a helix described by any point of its generatrix.

Let ρ = distance of any helix from an assumed vertical axis;
β = angle made by generatrix with horizon;
c = ordinate of point in which generatrix in its initial position cuts the axis;
z, y, s, and a as before. Then

$$y = c + \rho \tan \beta + s \tan a\,;\; z = (y - c - \rho \tan \beta) \operatorname{cosec} a \qquad (8)$$

If $\beta = o$, equations (8) will become

$$y = c + s \tan a\,;\; z = (y - c) \operatorname{cosec} a \qquad (9)$$

If $c = o$, equations (8) will become

$$y = \rho \tan \beta + s \tan a;\; z = (y - \rho \tan \beta) \operatorname{cosec} a \qquad (10)$$

and equations (9)

$$y = s \tan a\,;\; z = y \operatorname{cosec} a \qquad (11)$$

The general investigation is simple enough, but when the results are applied to particular cases, it assumes a more difficult form.

Helix on right cylinder with circular base.

h = height of cylinder; r = radius of base.

$$\left.\begin{array}{ll} z = h \operatorname{cosec} a; & s = h \cot a \\ \rho = r; & \phi = h r^{-1} \cot a \end{array}\right\} \qquad (12)$$

For the area of the helicoidal surface whose generatrix passing through the centre of the base in its initial position, does not extend beyond the surface of the cylinder.

$$A = r \sec \beta \cos a' \operatorname{cosec} a\,(h - r \tan \beta) \qquad (13)$$

$\sin a' = \sin a \sin \beta$; and if $\beta = o$, $a' = o$ also, and (13) becomes

$$A = r h \operatorname{cosec} a \qquad (14)$$

Right cone with circular base.

h = height of cone; r = radius of base.

$$\left.\begin{array}{l} z = y \operatorname{cosec} a;\; y = s \tan a \\ \rho = r h^{-1}(h - y) = r h^{-1}(h - s \tan a) \end{array}\right\} \qquad (15)$$

Substituting in (5),

$$s = h \cot a \left(1 - e^{-r \phi \tan a\,(h^2 - r^2 \tan^2 a)^{-\frac{1}{2}}}\right) \qquad (16)$$

From the last of equations (15,)

$$s = h \cot a\,(1 - r^{-1} \rho) \qquad (17)$$

Comparing (16) and (17),

$$\rho = r\, e^{-r \phi \tan a\,(h^2 - r^2 \tan^2 a)^{-\frac{1}{2}}} \qquad (18)$$

For the area of the helicoidal surface whose generatrix passing through the centre of the base in its initial position, does not extend beyond the surface of the cone.

$$A' = 2^{-1} r' \cos a' \operatorname{cosec} a\,(h - r \tan \beta) \qquad (19)$$

$\sin a' = \sin a \sin \beta$; $r' = r h\,(h^2 + r^2)^{-\frac{1}{2}} \operatorname{cosec}\left[\beta + \sin^{-1} h\,(h^2 + r^2)^{-\frac{1}{2}}\right]$

If $\beta = o$, then $a' = o$, and (19) becomes

$$A' = 2^{-1} r h \operatorname{cosec} a. \qquad (20)$$

Helix on sphere.

The plane of reference passes through the centre of the sphere.

r = radius of sphere ; z, s, &c., as before.

$$\left.\begin{aligned} z &= y \operatorname{cosec} a;\ y = s \tan a \\ \rho &= (r^2 - y^2)^{\frac{1}{2}} = (r^2 - s^2 \tan^2 a)^{\frac{1}{2}} \end{aligned}\right\} \quad (21)$$

Substituting in (5) and then placing for s its value derived from the last of equations (21) there results,

$$\left.\begin{aligned} \phi = &\tan^{-1}\left[\tan \tfrac{1}{2} a \left(r\cos a - \left[r^2 - \rho^2\right]^{\frac{1}{2}}\right)^{\frac{1}{2}} \left(r\cos a + \left[r^2 - \rho^2\right]^{\frac{1}{2}}\right)^{-\frac{1}{2}}\right] \\ &+ \tan^{-1}\left[\cot \tfrac{1}{2} a \left(r\cos a - \left[r^2 - \rho^2\right]^{\frac{1}{2}}\right)^{\frac{1}{2}} \left(r\cos a + \left[r^2 - \rho^2\right]^{\frac{1}{2}}\right)^{-\frac{1}{2}}\right] \\ &- 2 \operatorname{cosec} a \tan^{-1}\left[\left(r\cos a - \left[r^2 - \rho^2\right]^{\frac{1}{2}}\right)^{\frac{1}{2}} \left(r\cos a + \left[r^2 - \rho^2\right]^{\frac{1}{2}}\right)^{-\frac{1}{2}}\right] + c \end{aligned}\right\} \quad (22)$$

(22) is the equation of the projection of the helix traced on the upper half of the sphere.

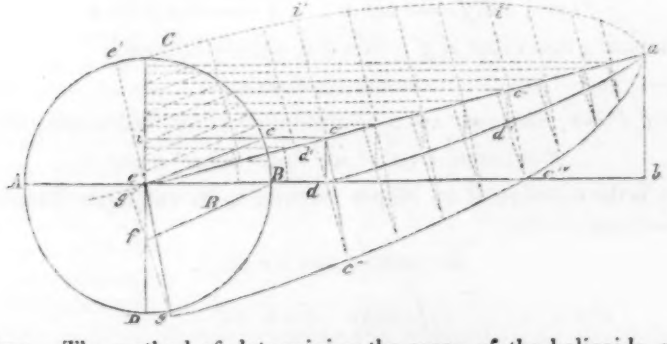
For the area of the helicoid whose generatrix passing through the centre in its initial position, does not extend beyond the surface of the sphere.

$$\left.\begin{aligned} A'' = 2^{-2} r^2 (&\cos a' \operatorname{cosec} a \sec \beta \left[\pi - 2 \sin \beta \cos^2 a \right. \right. \\ &\left. \left. \left(1 - \sin^2 \beta \cos^4 a\right)^{\frac{1}{2}} - 2 \sin^{-1}\left(\sin \beta \cos^2 a\right)\right] - \sin 2a'\right) \\ &\sin a' = \sin a \sin \beta. \end{aligned}\right\} \quad (23)$$

If $\beta = 0$, $a' = 0$, and (23) becomes

$$A'' = 2^{-2} r^2 \pi \operatorname{cosec} a \quad (24)$$

By proceeding in the same manner, helices may be readily located on ellipsoids, paraboloids, and hyperboloids of revolution. Their determination will be found to present several interesting examples of the integral calculus, and will be instructive and entertaining.



NOTE.—The method of determining the areas of the helicoids, generated in the several cases considered, does not appear very plainly in the

preceding investigation; and I present here, in the form of a note, an example of the general method by determining the area of the helicoid in the case of the sphere.

Roll the sphere along the great circle A B. The helix traced by the extremity of the generatrix which passes through *e*, and is perpendicular to the plane of the paper, will drop off and become *e a*: the one traced by the extremity of *e i*, represented in its true length by *e c*, and which makes the angle $c\,e\,\text{B} = \beta$ with the plane through *e* perpendicular to C D, will drop off and become *c' a*. The helicoid generated by the first, is projected in *e a*. Revolving it about *e a* until it coincides with the plane of the paper, it becomes $e\,c'\,c''\,a\,i''\,i'\,e'$. The helicoid generated by the second is projected in $c'\,c''\,a\,d'\,d$. Revolving it about *c' a* until it coincides with the plane along which the sphere is rolled, it becomes $c'\,c''\,a\,c^{IV}\,c'''$.

$$c'\,i' = \rho = (r^2 - y^2)^{\frac{1}{2}} = (r^2 - z^2 \sin^2 a)^{\frac{1}{2}}. \quad \text{Hence}$$

$$\rho^2 + z^2 \sin^2 a = r^2 \qquad (a)$$

By a simple transformation (*a*) becomes

$$r^2 \operatorname{cosec}^2 a. \quad \rho^2 + r^2 z^2 = r^4 \operatorname{cosec}^2 a \qquad (b)$$

(*b*) is the equation of an ellipse, the axes being $2r$ and $2r \operatorname{cosec} a$.

The area of $e\,c'\,c''\,a\,i''\,i'\,e'$ can be readily found now; though it is best to take the more general case in which the generatrix makes an angle β with the plane through *e*, perpendicular to C D. $c'\,c''\,a\,c^{IV}\,c'''$ is the helicoid whose generatrix, passing through the centre of the sphere in its initial position, does not extend beyond the surface, whilst $e\,c'\,c'\,a\,c^{IV}\,c''\,g$ is the helicoid whose generatrix is seen in projection in *f e*, and in its true length in *f* B, and which makes an angle with β the plane of reference.

$$e\,c'\,c''\,a\,c^{IV}\,c'''\,g = g'\,e\,c'\,c''\,a\,c^{IV}\,c'''\,g - g'\,e\,g \qquad (c)$$

$g'\,e\,g$ is a right triangle, and is equal to $\frac{1}{2}\,g\,g' \times g'\,e$.

Let $g'\,g\,e = a'$, then, since $e\,g = f\,\text{B} = r \sec \beta$,

$g\,g' = r \sec \beta \cos a'$, and $g'\,e = r \sec \beta \sin a'$. Hence

$$g'\,g\,e = \tfrac{1}{2}\,r^2 \sec^2 \beta \sin a' \cos a' = 2^{-\frac{1}{2}}\,r^2 \sec^2 \beta \sin 2\,a' \qquad (d)$$

$g'\,f\,e = a$, and $f\,e = r \tan \beta$. $\therefore\ g'\,e = r \tan \beta \sin a$

Comparing this value of $g'\,e$ with that already obtained,

$$\sin a' = \sin a \sin \beta. \qquad (e)$$

Let $c'\,c''' = \text{P}$, then $\rho = \text{P} \cos \beta$. Substituting in (*a*), and transforming,

$$\text{P}^2\,r^2 \operatorname{cosec}^2 a + z^2\,r^2 \sec^2 \beta = r^4 \operatorname{cosec}^2 a \sec^2 \beta. \qquad (f)$$

(*f*) is the equation of an ellipse referred to its conjugate diameters, the diameters being

$$2r \operatorname{cosec} a \text{ and } 2r \sec \beta.$$

$$d''\,c'\,c'\,a\,c^{IV}\,c''' = \int \text{P} \cos a'\,dz = \text{A}'' + d''\,c'''\,c' \qquad (g)$$

$$d''\,c'''\,c' = \tfrac{1}{2}\,d''\,c''' \times d''\,c' = \tfrac{1}{2}\,r \cos a' \times r \sin a' = 2^{-2}\,r^2 \sin 2\,a' \qquad (h)$$

Substituting in (*g*) and transposing

$$A'' = \int p \cos a' \, dz - \frac{-2}{2} r^2 \sin 2a' \qquad (i)$$

From (*f*), $p = \sec\beta\,(r^2 - z^2\sin^2 a)^{\frac{1}{2}} = \sec\beta \sin a\,(r^2\operatorname{cosec}^2 a - z^2)^{\frac{1}{2}}$

Substituting in (*i*),

$$A'' = \cos a' \sin a \sec\beta \int (r^2\operatorname{cosec}^2 a - z^2)^{\frac{1}{2}} dz \qquad (k)$$

Integrating and taking z between the limits

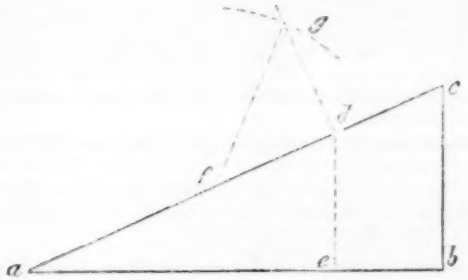
$z = e\,a = r \operatorname{cosec} a$, and $z = c\,d'' = r \sin\beta \cos^2 a \operatorname{cosec} a$.

$$A'' = \frac{-2}{2} r^2 \Big(\cos a' \operatorname{cosec} a \sec\beta \Big[\pi - 2\sin\beta\cos^2 a \Big(1 - \sin^2\beta\cos^4 a\Big)^{\frac{1}{2}} - 2\sin^{-1}\Big(\sin\beta\cos^2 a\Big)\Big] - \sin 2a' \Big) \qquad (m)$$

(*m*) is the same as (23).

If z be taken between the limits, $e\,g' = -r \sec\beta \sin a$; and $e\,a = r \operatorname{cosec} a$, $g'\,e\,c'\,c''\,a\,c^{IV}\,c'''\,g$ will be obtained, then subtracting $g'\,g\,e$ the area of the helicoid $e\,c'\,c''\,a\,c^{IV}\,c'''\,g$, whose generatrix is seen in projection in $f\,e$ will be obtained.

Equation (*a*) gives rise to the following method of determining points of the ellipse.



The semi-axes being given, construct a right triangle $a\,b\,c$, whose hypothenuse is equal to the semi-major axis, and the altitude to the semi-minor axis. At any point, as d, on the hypothenuse erect a perpendicular thereto, and through the same point let fall a perpendicular $d\,e$ on the base $a\,b$; then lay off $d\,f$ on the hypothenuse equal to $d\,e$, and with f as a centre, and a radius equal to $b\,c$, the semi-minor axis, describe an arc cutting the first perpendicular in g; g will be one point of the ellipse. Other points can be determined in the same way, and the curve then traced through them. It is evident that g will be one point of the ellipse. For, in equation (*a*), ρ denotes the ordinate, and z the abscissa; and if, in the figure, $a\,d = z$, $d\,g = \rho$, $b\,a\,c = a$, there will result,

$$d\,e = d\,f = z \sin a; \text{ and consequently,}$$

$$(f\,g)^2 = r^2 = \rho^2 + z^2 \sin^2 a \qquad (n)$$

AMERICAN PATENTS.

List of American Patents which issued from February 10th, to March 3d, 1857, (inclusive,) with Exemplifications.

FEBRUARY 10.

56. For an *Improvement in Stuffing Leather;* Joseph Armstrong, Woburn Centre, Massachusetts.

Claim.—"Employing a press previous to, and in connexion with, the application of the oil or grease by a peg-lined cylinder, or other equivalent means, the press removing the liquor and contracting the hide, and the peg-lined cylinder, subsequently restoring or plumping it and impregnating it with grease."

57. For an *Improvement in Melodeons;* J. C. Briggs, Woodbury, Connecticut.

Claim.—"The expression chamber with its valve."

58. For an *Improvement in Fire Arms;* Francis S. Brettell and John B. Frisbie, Alleghany City, Pennsylvania.

Claim.—"The arrangement of the pawl or catch, notch, and claw on the hammer, and the cam on the trigger, or any other arrangement substantially the same, for the purpose of keeping the hammer and the trigger in their respective positions when at full cock."

59. For an *Improved Machine for Making Envelopes;* Theodore Bergner, Philadelphia, Pennsylvania.

Claim.—"1st, Giving the sliding rod a downward movement, by means of link, lever, rod, and cam. 2d, Giving a sliding movement to the frame, by means of link, lever, rod and cam, thereby operating, by means of lifters, the folding hinges. 3d, The compartments, in combination with pipe and cylinder, the latter being provided with piston, which is operated by cam on the shaft. 4th, The stamp, working in the swivel bearing, and operated by cam, pin, rod and cam. 5th, The employment of cam-lever, rod-arm, and spiral spring, to turn swivel bearing on its axis. 6th, Operating the pasting vessels, by the lever, rod, and cam. 7th, Applying the curved arm, working in a slot, through the folder, for removing the finished envelopes to the inclined table, and operating it by arm, and cam-arm."

60. For an *Improved Mode of Attaching Thills to Sleighs;* J. M. Batchelor, Foxcroft, Maine.

Claim.—"Attaching the thills to the bar, which bar is fitted within a grooved bar attached to the sleigh—the bar being allowed to slide within the grooved bar, and secured at the desired points by the spring catch."

61. For an *Improvement in Extension Hoppers for Separators, Grain Mills, &c.;* John Bean, Hudson, Michigan.

Claim.—"The combination of an adjustable extension piece, with the hopper."

62. For an *Improvement in Shoes for Truss Frames;* Reuben Comins, Troy, N. Y.

Claim.—"Furnishing that description of shoe, which at the part where the braces rest is of an inverted T, or angular or curved form, with two projecting plates on its under side, which, in their horizontal section, are of T form—said plates passing through the stringers on each side of the vertical rods, and thus forming an opening, or jaws, for the vertical rods to pass between, and extending down from the surface of the shoe which rests upon the stringers, to the nuts and washers upon the under side of the stringers."

63. For *Improved Gunpowder;* Elisha B. Dodson, Reading, Pennsylvania.

Claim.—"The treatment of mineral coal, preparatory to using the same as a substitute for charcoal, in the manufacture of gunpowder and blasting powder."

64. For an *Improved Printing Stamp;* Wm. H. Elliot, Plattsburgh, New York.

"The nature of my invention consists in the arrangement of certain devices for a printing stamp, by which the type or die is caused to pass from the ink pad or roll, to

the impression pad to make the impression, and back to the ink pad again for the ink—the power being applied by the hand or foot."

Claim.—"1st, The crank, joint, or their equivalents, when used in combination with type or die. 2d, The same, in combination with the treadle. 3d, The self-adjusting ink pad. 4th, Tilting the ink pad, so that by the action of the type, or dies upon it, it may be revolved. 5th, The combination of the die or type with the crank, when arranged in relation to the two pads."

65. For an *Improved Raking Attachment for Reapers;* Peter Harnist, Marinetown, Illinois.

Claim.—"Operating the rod to which the rake head is pivoted, by means of rock-shaft arms, and connecting in combination with spring, crank, and bar."

66. For an *Improvement in Razor Strops;* Edward K. Godfrey, City of New York.

Claim.—"The use of an independent strop stock, without handles, in combination with adjustable and independent backs."

67. For an *Improvement in the Mode of Attaching the Eyes to the Blades of Hoes;* Henry Havell, Newark, New Jersey.

Claim.—"The cap which forms a socket with the blade to receive the malleable iron eye, and becomes a part of the same."

68. For an *Improvement in Seed Planters;* Thomas B. Houghton, Bloomington, Ill.

Claim.—"Operating the planting slide and tube, by means of a crank receiving its motion from one or both of the carriage wheels. Also, the reciprocating frame, or its equivalent, so constructed and operated as to guide the planting tube, and make it deposit the seed in the ground at the desired point."

69. For an *Improvement in Guides for Sewing Machines;* Addison Hull, Brooklyn, New York.

Claim.—"The attachment of the guide plate to a spring bar, or its equivalent, which operates independently of the foot piece, thus holds the cloth during the sewing operation, and is adjusted laterally to the same, and the connexion of the same by a vertically slotted connexion, with a slotted sliding plate working through the foot piece, whereby the guide plate is made adjustable and changeable."

70. For an *Improved Machine for Ramming Percussion Caps;* Charles Hicks, Haverstraw, New York.

Claim.—"1st, The pistons, arranged in a row, and receiving reciprocating rectilinear and circular movements, simultaneonsly operating, in combination with the traveling carrying plate, or other equivalent device, for carrying the caps. 2d, Producing the circular movement of the piston by means of pinions on the said pistons, gearing with a toothed rack that receives a sliding movement laterally to the frame which carries the pistons, and imparts to them the rectilinear movement from a lever operated by a cam on the crank-shaft, by which the rectilinear movement of the pistons is produced. 3d, The employment of the stationary plate, in combination with the reciprocating pistons, and the traveling carrying plate."

71. For an *Improved Method of Surfacing Felt Hats;* Alvin Hurd, Danbury, Conn.

Claim.—"Surfacing the hat upon the elastic cover or bed."

72. For an *Improvement in Feathering Paddle Wheels;* Lewis T. Howard, Smith Mills, Mississippi.

Claim.—"The connecting the cranks of the paddle shafts with each other, around and with the stationary governing wheel, by means of the connecting bars, and the grooved rollers, or their equivalents."

73. For an *Improvement in Seed Planters;* John Hildebrand, East Berlin, Penna.

Claim.—"The combination of the spring connexion, and slides, and scrapers, and the vibrating head cam."

74. For an *Improved Gas Making Process;* James Hansor, Wandsworth Road, England.

Claim.—"The treatment of the compound gas fuel, worked in the retorts."

75. For an *Improvement in Seed Planters;* Reinhold Bocklen, Jersey City, N. J.

Claim.—"The distributor, having chamber and recesses, and worked between the compartments, and by means of the link and slide, in combination with the cut-off and plate."

76. For an *Improved Arrangement of Means for Controlling the Throttle Valve of Marine Engines;* Wm. H. Elliot, Plattsburgh, New York.

Claim.—"The chamber, cylinder, plunger, and spring, when arranged in relation to the engine and to the hull of the vessel, and to each other."

77. For an *Improved Sash Fastener;* Wm. W. Kellogg, Lynn, Massachusetts.

Claim.—"The use of the hasps constructed and operating in connexion with the perforated cleat and upper sash."

78. For an *Improvement in Safety Indicators for Steam Boilers;* Lucius J. Knowles, Warren, Massachusetts.

Claim.—"Connecting the pipe with the boiler by means of the feed pipe, the same being productive of an advantage."

79. For an *Improvement in Seed Planters;* Jacob Landes, Selma, Ohio.

Claim.—"Pivoting the cut-off to the bar, so that the cut-off shall have an oscillating movement, and thus stir the seed when it oscillates."

80. For an *Improved Fence adaptable to Uneven Ground;* G. R. McIlroy, Covington, Kentucky.

Claim.—"The combination of the adjustable bar and oblique pin, with an angularly braced panel and bearer, or any ordinary panel on which the angular or other bar may be supported, so that the panels may be moved sideways at the bottom, so as to bring them perpendicular upon uneven ground, and secured in that position by one or two adjustable bars or seats."

81. For an *Improvement in Reaping and Mowing Machines;* Jeremiah W. Mulley, Amsterdam, New York.

Claim.—"Constructing and arranging the platform of combined reaping and mowing machines in parts, when one or more of said parts may occupy at pleasure such position in relation to the cutters as to form the track clearer for mowing, or the platform for reaping."

82. For an *Improved Process for Ornamenting Daguerreotype Cases, &c.;* John F. Mascher, Philadelphia, Pennsylvania.

Claim.—"The process of ornamenting daguerreotype cases, or other articles, in imitation of tortoise shell, wood, marble, or other substances, by first covering the surfaces thereof with stained or colored paper of suitable character, or staining or coloring the surfaces themselves in a suitable manner, and afterwards coating them with gelatine, and bi-chromate of potash."

83. For an *Improvement in Preparing India Rubber Cloth;* Gulielmus B. Millerd, Colchester, Connecticut.

Claim.—"The application of a sheet of vulcanized caoutchouc, previously prepared by buffing its surface or surfaces to a sheet of cloth, or between two sheets of cloth previously prepared, by being thinly coated with an unvulcanized solution of caoutchouc on the tangent side or sides; the sheet of caoutchouc being applied in an extended state to produce an extensible and elastic, or in a free state to produce an unelastic."

84. For an *Improved Abdominal Supporter;* Julia M. Milligan, New Albany, Ind.

Claim.—"The application of the whalebone, and the cords or strings, by which the requisite mechanical support may be obtained."

85. For an *Improvement in Chain Pumps;* Edmund Morris, Burlington, N. J.

Claim.—"The application of an elastic flexible tube, in combination with the box or chamber in which it is enclosed, for the purpose of retaining water to assist in packing the pump."

86. For an *Improvement in Gauges and Water Regulators for Steam Boilers;* Mighill Nutting, Portland, Maine.

Claim.—"The arrangement of the expanding chamber in relation to the opening for

steam in the heating apartment, so that the steam from the boiler, when it is admitted to this apartment, is suddenly brought into contact with the surface of the lower part of the chamber, within the apartment, and remains in contact with the same until the water in the boiler rises to the top of the opening which admitted the steam, when the contact of the steam with the chamber is suddenly cut off."

87. For an *Improvement in Rail for Street Railroads;* Samuel Nicolson, Boston, Mass.

Claim.—"My improved street rail, with recesses in its side or sides, for the reception of the paving blocks, each recess of one side being opposite either a recess of the other side, or space between two recesses of the other side."

88. For an *Improved Arrangement of Devices for Suspending and Adjusting Sticks in Sawing Machines;* Ezekiel Page, Platea, Pennsylvania.

Claim.—"Constructing the head and tail blocks of a saw-mill, in which the log is so suspended as to rotate with the vertical and lateral adjustments, arranged and combined so that the log may be sawed radially and tapering for the purpose of getting out oars therefrom."

89. For an *Improvement in Ventilating Stoves;* Luther M. Parsons, Wawkan, Wis.

Claim.—"The arrangement of the pipes, bent pipe, bar, provided with valves, and the expansion rod."

90. For an *Improved Hand Stamp;* Perley A. Ramsay, Boston, Massachusetts.

Claim.—"1st, The arm, pivoted to the truck, in combination with the stop and ink roll. 2d, The method of hanging the ink roll."

91. For an *Improvement in Sewing Machines;* Thomas J. W. Robertson, City of New York.

Claim.—"The spiral groove in the needle leading upward from the eye on one side, in combination with the looper. Also, the loop guide, in combination with the looper for laying the loop. Also, the guard pin, or its equivalent."

92. For an *Improvement in Seed Planters;* Silas G. Randall, Rockford, Illinois.

Claim.—"In combination with the shoe or spade, composed of the pieces, the bars."

93. For an *Improvement in Corn Planters;* Martin Robbins, Cincinnati, Ohio.

Claim.—"The reversible hopper and arms, with the vibrating claw or tappet connected with seeding mechanism, in combination with the jointed rod or chain provided with buttons or similar devices."

94. For an *Improvement in Attaching the Arms of Horse Powers;* Cyrus Roberts, Belleville, Illinois.

Claim.—"The combination of the radial rigid arms and intermediate hinged and suspended sweeps with the master-wheel."

95. For an *Improvement in Rotary Steam Engines;* John B. Root, Buffalo, New York.

Claim.—"1st, The central hub when used as a support for friction rollers. 2d, The arrangement of friction rollers within the piston, upon the central hub. 3d, The piston, when used in acting upon friction rollers, 4th, The combination of the sliding frame, the self-adjustable boxes, the driving-ring, and the wedge, for the purpose of regulating the bearing of the friction rollers upon the piston and central hub."

96. For an *Improved Metallic Roofing;* Benjamin Ross and John C. Campbell, Syracuse, New York.

Claim.—"The method of connecting together metallic plates or shingles for roofing by their own weight, when the series of plates so connected are fastened only at the upper and lower edge of the roof."

97. For an *Improvement in Instruments for Facilitating the Facing of Mill-Stones;* Benjamin D. Sanders, Holliday's Cove, Virginia.

Claim.—"The instrument consisting of the slotted beam, cross-arm, elastic pointer, box carrying the adjusting screw, spindle, and adjustable base or stand, or the equivalent of these devices, constructed and arranged in relation to each other for joint operation."

98. For an *Improved Self-Adjusting Wind-Wheel;* Edward A. Tuttle, Brooklyn, New York.

Claim.—"Placing the sails, or a greater number, in a position before the wind, and then causing them to perform complete rotation upon their axis, in the time relatively with those of the wind-wheel, and in the direction by connecting them with the crown-wheel, in any manner producing the same result. Also, the crown-wheel and vane, connected with the sails by means of the pinion wheels. Also, combining with the horizontal rotary motion of the sails upon their axis, the perpendicular, adjustable, vibratory motion, by which they are rendered self-regulating in a most simple manner, although presenting reverse sides to the wind at each succeeding revolution of the wind-wheel. Also, the method of assisting the sails to perform their rotation upon their axis, by means of the reverse projecting arms upon the bottom edges."

99. For an *Improvement in Seed Planters;* H. Thomason, Lafayette, Indiana.

Claim.—"Operating the distributing device or slide, by means of the lever or rod, having the arm attached to its fulcrum bar, which has a spring connected with it and the collar or tube, on the handle of the implement; the collar or tube being provided with an arm extending underneath the arm of the fulcrum bar."

100. For an *Improvement in Harvesting Machines;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"Making the raker's seat or stand adjustable in the arc of a circle, on the rear part of the frame."

101. For an *Improvement in Harvesting Machines;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"In combination with the finger bar and shoe, a track clearer hung to said bar by a spring, and playing vertically between, but resisted laterally by the lugs on said shoe, when said parts are constructed and arranged in relation to each other."

102. For an *Improvement in Harvesting Machines;* Walter A. Wood, Hoosick Falls, New York.

Claim.—"Connecting and disconnecting the gear by a clutch lever, with its cam planes and handle extending up through the support, to a convenient position for the operator."

103. For an *Improvement in Apparatus for Indicating the Height of Water in the Holds of Vessels;* Wm. R. Warden, Boston, Massachusetts.

Claim.—"Operating the alarm apparatus, by means of the ball carrier's inclined tube and lever, with their co-operating mechanism."

104. For an *Improvement in Wool Cleaning Machines;* William H. Watrons, Brooklyn, New York.

Claim.—"The combination of the picker cylinder, reciprocating screen, exhaust screen, and fan-blower."

105. For an *Improvement in Locomotive Cow-Catchers for Railroads;* Joel Wisner, Aurora, New York.

Claim.—"1st, The bar or jaw, legs, feet, and teeth, when operated by the springs, or their equivalent, in combination with the forward end beam of the locomotive. 2d, The stud and joint, in combination with the bar."

106. For an *Improved Machine for Re-sawing Lumber;* Simon P. Winne, Albany, New York.

Claim.—"1st, Connecting the slides of the two roller frames by arms. 2d, Connecting the two upper and outer rollers in the frames, to the two lower rollers in the frames, by means of the rods, so that a rotary motion is communicated to the lower rollers from the upper ones, and the upper rollers allowed to have an independent lateral movement."

107. For an *Improvement in Fishing Rod Reels;* Edward Deacon, Brooklyn, N. Y., Assignor to John Warren, City of New York.

Claim.—"Connecting the crank-shaft with the reel-shaft, and also disconnecting it therefrom, by means of the slotted sleeve placed or fitted upon the shaft, and within the socket."

108. For an *Improved Machine for Cutting Dovetails and their Grooves;* E. G. Matthews, Clear Water, Minnesota Territory, Assignor to Harvey Church, Troy, New York.

Claim.—"In combination with the fixed stock, the mitering knife, and scouring and cleaning knives, for forming, at one operation, the miter and dovetail, tongue or groove. Also, in combination with the fixed stock, and mitering, and dovetail cutter, the traversing of the block or board in a clamped condition past the same, for the purpose of having the miter and dovetail formed therein."

109. For an *Improvement in Calendar Clocks;* Edwin P. Monroe, Albany, N. Y., Assignor to Gilbert H. Scribner, City of New York.

Claim.—"The displacing of cards, for the purpose of enumerating and designating the day, said cards being suspended upon wires, and displaced by means of a hand, moved and operated by the machinery of the common hour clock, or by any other machinery appropriate for the same purpose."

110. For an *Improved Mode of Patching Bullets;* Frederick D. Newbury, Assignor to Richard Varick De Witt, Jr., Albany, New York.

Claim.—"The mode of securing a patch upon conoidal or similar bullets, by compressing the upper portion of the patch under a thin ledge of the metal of the bullet."

111. For an *Improved Arrangement of Springs for Vehicles;* Darius Babcock, Assignor to self, and Thomas Harrop, Homer, New York.

Claim.—"The combination of the c spring and sinuous spring, connected by rigid bars to the body of the vehicle."

112. For an *Improvement in Making Seamless Tubes;* Wm. S. Platt, Assignor to self, and Alfred and Clark M. Platt, Waterbury, Connecticut.

Claim.—"So forming the groove upon each sector, that the breadth and depth thereof shall gradually diminish from one end to the other, whereby the size of the central hole formed by a set of the said sectors, when arranged for operating, shall increase or diminish as the sectors vibrate or rotate."

113. For an *Improvement in Manufacturing Metallic Beads;* John R. Wendt, Assignor to self and Augustus Rogers, Boston, Massachusetts.

Claim.—"My improved manufacture of hollow beads of metal, as made by the operations of reducing the metal to a tubular form, and that of compressing it axially in dies."

114. For *Improved Window Blinds;* Daniel Kelley and William Livingston, Grand Rapids, Michigan.

Claim.—"Constructing the slats, and having strips attached to the stile, whereby the slats, when closed, will overlap and be flush with each other, at each side, and the slats rendered perfectly weather proof, and the light excluded."

115. For an *Improvement in Machines for Husking Corn;* Ezra S. Holmes, Lockport, New York.

Claim.—"1st, The huskers, consisting of the guides and of the hands, or their equivalents. 2d, The combination of the huskers with the shears."

116. For an *Improved Process for Smelting Zinc Ore;* Joseph C. Kent, Cooper Iron Works, New Jersey.

Claim.—"The peculiar process of alternating in the blast furnace, the Franklinite, and other ores of iron and zinc, with ordinary ores of iron, for the production of cast iron and oxide of zinc, by which process I maintain the equilibrium of heat, and keep the furnace in successful operation."

FEBRUARY 17.

117. For a *Self-setting Hair-Triggered Gun Lock;* Jonathan Altman, Armstrong Co., Pennsylvania.

Claim.—"The mode of setting the double trigger by the act of cocking the gun."

118. For an *Improvement in Extension Chairs;* Samuel J. Anderson and Nelson Richardson, Erieville, New York.

Claim.—"The levers and folding seats attached to the box, the box being formed of two parts connected by a hinge."

119. For an *Improvement in Seed Planters;* Leonard Arnold, Janesville, Wisconsin.

Claim.—"Employing two frames in constructing the machine, the forward frame resting on the axle of the principal or driving-wheels, and the rear frame resting on the axle of the covering-wheels, and extending forward and under the forward frame to which it is jointed, and acting as a lever in elevating the forward frame, driving-wheels, and ploughs, clear from the ground, in turning round and passing from point to point."

120. For *Photographic Camera Box;* Luzerne M. Bolles and Washington G. Smith, Cooperstown, New York.

Claim.—"1st, A swing, with ground glass permanently attached. 2d, The arrangement of the baths in the camera box to correspond with the operations of the plate holder, through the mortise and grooves."

121. For an *Improved Machine for Making Hames;* Henry Burt and James T. Hedden, Newark City, New Jersey.

Claim.—"The use of the consecutive ring dies, in connexion with the angular grooves and stops on the feed rollers."

122. For an *Improvement in Gas Regulators;* John H. Cooper, Philadelphia, Pa.

Claim.—"Placing the spring regulating the valve within the latter, made hollow for the purpose, in order to prevent the contact of the gas with the spring."

123. For an *Improvement in Bosoms Pins;* John P. Derby, South Reading, Mass.

Claim.—"Extending the arm around the end and along the side of back of brooch, so that the point of pin being retained in the fingers can be entered under its extreme end, thus allowing said point to be protected by a guard when revolved to place. Also, the combination of collar with the cap and the post, which admits of the easy attachment of the pin."

124. For an *Improved Carpenter's Bench Clamp;* James E. A. Gibbs, Mill Point, Virginia.

Claim.—"Combining the pivoted and bent clamp rod, with the sliding arm or lever, when the latter is so arranged as to jam the rod at any required height, by means of screw or cam, or any other equivalent mechanical contrivance."

125. For an *Improved Device for Allowing Circular Saws to Play Laterally, Independently of their Shafts;* A. P. Gross, St. Louis, Missouri.

Claim.—"The shaft, in combination with the sleeve and springs, the saw being attached to the sleeve, and the shaft secured in its bearing so as to prevent a longitudinal movement of the same."

126. For an *Improved Chimney Cowl;* Moses H. Hale and Samuel Horton, Newburyport, Massachusetts.

"Our improvement has reference to the chimney cap or ventilator, on which Letters Patent of the United States of America, were granted to Frederick Emerson, of Boston, Massachusetts.

Claim.—"The improved cap constructed with a discharge pipe, the inverted frustrum, the outer frustrum, its wind passages, and the shield or fender."

127. For an *Improved Method of Generating Air Blast;* Isaiah J. Hendryx, City of New York.

Claim.—"1st, The cylinder constructed with a hollow shaft, and divided into compartments either on a line with the shaft, or spirally around it, said cylinder being partly immersed in water or other liquor, and revolving at an angle. 2d, The cylinder, with or without a hollow shaft, and extending the air chamber above and below the cylinder, said chamber passing far enough below the water line to prevent the escape of the air, the air being supplied to the cylinder through the hollow shaft, or by pipes passing along it to the outside of the chamber, said pipes having valves opening inwards or immersing. 3d, The cylinder, revolving at an angle without being immersed with the

liquor inside said cylinder. 4th, The application and use of the cylinder, its case and contents, for the purpose of passing air through hydro-carbons and their vapors, or mixing air with other gases, for heating or illuminating, or any other purpose requiring a steady blast; I do not limit myself to the form of a cylinder, but claim any other shaped vessel, constructed of metal or other material."

128. For an *Improved Machine for Varnishing Percussion Caps;* Charles Hicks, Haverstraw, New York.

Claim.—"1st, The combination of a vertically moving frame, carrying a number of wires or rods, or their equivalents, to take up the varnish, and suitable guides above the said trough to receive a plate which carries the caps: the whole being constructed and operated together. 2d, The plate containing holes corresponding in number and arrangement with the wires or rods, or their equivalents, arranged relatively to the trough, the vertically moving frame, and the guides."

129. For an *Improvement in Folding Bedsteads;* Benjamin Hinckley, Troy, N. Y.

Claim.—"Connecting and bracing the folding portions and intermediate legs by the double cog hinges attached to the side rails, and having their bearings in the intermediate posts."

130. For an *Improved Gearing for Wagons;* Edgar Hudson, Ithaca, New York.

Claim.—"So making the frame as to leave the forward extremities of said frame open, so as to receive the pole or thills between and back of the forward ends of the side springs—thus bringing the animal nearer the wagon, and thereby making the draft easier, and requiring less room in which to turn."

131. For an *Improved Brick Press;* Samuel Lillie, Jr., Fort Wayne, Indiana.

Claim.—"Forcing the clay into the moulds, and compressing it therein by means of a hollow plunger, fitted and working within the box, and connected with the platform on which the moulds are placed, so that the plunger and mould to be fitted rise and fall together."

132. For an *Improvement in attaching Extra Topsails to Vessels;* E. H. Linnell, Orleans, Massachusetts.

Claim.—"Attaching and hanging the extra topsail yard to the topmast itself, by means of the combination of the collars, and turning on the topmast the forked brace connecting said collars, and the stationary annular plate on which the lower collar rests and turns, so that said extra topsail yard shall swing from the axis of the topmast as a centre."

133. For an *Improvement in Gas Retorts;* Michael J. Miller, St. Louis, Missouri.

Claim.—"The pipe inserted so as to receive the gas at the bottom of the retort."

134. For *Improved Machinery for Excavating Rock;* Jesse C. Osgood, Troy, N. Y.

Claim.—"1st, Excavating rock under water by means of the wedge-shaped chisel, whose length is greater than the depth of water. 2d, The spring head, or its equivalent, in combination with the chisel. 3d, The arrangement of the spring within the loop or strap of the turn buckle, in combination with the sliding nut."

135. For an *Improved Mode of Fastening Skates;* Henry Pickford, Boston, Mass.

Claim.—"Uniting the skate blade to the sole of the boot or shoe."

136. For an *Improvement in Self-disengaging Car Coupling;* Joshua C. Price, New Philadelphia, Ohio.

Claim.—"The employment of two obliquely set sliding head blocks, stop bars, connected by a turning link or plate, which is hollowed out and beveled inward on each of its edges, in combination with the hinged buffer pin plate, which is furnished with two outwardly beveling projections on its under side, said parts being arranged relatively to the buffer head."

137. For an *Improved Device to Allow Circular Saws' end play Independently of the Driving Shaft;* Wm. S. Reeder, St. Louis, Missouri.

Claim.—"The arrangement and combination of an additional driving-shaft, with the shaft that carries the saw."

138. For an *Improvement in Boat Oars;* Rufus Rode, Manchester, Pennsylvania.

Claim.—"The means by which I back water when the oar is to be used for that purpose, the oar to return to its place when feathering by means of lever, fulcrum, and springs."

139. For an *Improvement in Manufacturing Spinning Flyers;* John N. Sawtell, Lowell, Massachusetts.

Claim.—"The manufacture of flyers casting on the polished arms, the neck or nozzle, of metal, when the former are prepared by the application of a proper composition, so as to render the adherence of the nozzle to the arms secure."

140. For an *Improvement in Machinery for Harvesting Grain and Grass;* William and Thomas Schnebly, Hackensack, New Jersey.

Claim.—"The thin trapezoidal shaped finger or guard, in combination with the cutters, when said finger is constructed with an open area or space, conforming to the same finger, and with recesses in front and rear to support and guide the cutters near the centre of the finger or guard."

141. For an *Improved Machine for Splitting Shoe Pegs;* Nathaniel H. Shaw, Farworth, New Hampshire.

Claim.—"The feeding blade, whereby its movement is produced and adjusted to suit all the requirements of the machine, under all circumstances, in the most simple and perfect manner. Also, the arrangement of the holding bar in such a manner as to enable its motions to be produced without interference with alternate action of the splitting knife and feeding blade, and to be adjusted for the different sizes of pegs, so as not to disarrange the relative positions and movements of said holding bars, splitting knife, and feeding blade."

142. For an *Improvement in Harness for Horses;* Joseph Smith, Delaware, Ohio.

Claim.—"1st, The said bars, connected by cross-bar, or their equivalents. 2d, Pads or their equivalents. 3d, Triangular couplings, or their equivalents."

143. For an *Improved Mode of Securing Hubs on Axles;* Alfred E. Smith, Bronxville, New York.

Claim.—"The mode of securing the pipe box and hub on the axle, by forming the inner end of the pipe box with a flanch fitted to enter a recess in a collar fitted and secured into the inner end of the hub, when this is combined with a projecting collar on the axle, and a loop ring on the axle, and the collar on the hub being connected by turn buttons, or equivalents."

144. For an *Improvement in Feed-water Apparatus to Steam Boilers;* Andrew J. Vandegrift, Delaware, Ohio.

Claim.—"The fourth valve and the escape pipe."

145. For an *Improved Machine for Fitting Gas Pipes;* Caleb C. Walworth, Boston, Massachusetts.

Claim.—"The coupling constructed with long, short, and inclined faces."

146. For an *Improvement in Damper Regulators for Steam Boilers;* Wm. Webster, Morrisania, New York.

Claim.—"The arrangement of the several parts.

147. For an *Improvement in Electric Telegraphs;* Wm. D. Wesson, Chilicothe, Ohio.

Claim.—"Constructing the stationary telegraph line of a series of immovable and interposed movable conductors, and furnishing the vehicle with a circuit breaker, circuit receivers, and conductors, arranged to operate for the purpose of breaking the circuit through the main line, at a point or points where the vehicle is passing and completing the circle through, so that by suitable telegraphing instruments or apparatus carried by the vehicle, communications may be transmitted and received by the vehicle to and from other vehicles, or to or from stations at a distance, either while the vehicle or vehicles are stationary or in motion."

148. For an *Improvement in Machines for Paring Apples;* David H. Whittemore, Worcester, Massachusetts.

Claim.—"1st, Giving the slide (with its slicing knife attached,) a curved or lateral

motion for the purpose of enabling the slicing knife to leave the core in a shape for the easy removal of the apple. 2d, The arrangement consisting of the traveling knife carriage, with its tilting lever playing over the guard, which keeps the lever engaged with the screw while the apple is being pared, and releases it for the free return of the carriage."

149. For an *Improvement in Machines for Cutting Vegetables;* H. A. Willard, Westminster, Vermont.

Claim.—"The cutter, in combination with the metallic cutter plate, together with the particular arrangement of the cutters upon the cutter plate in such a manner that several are acting upon the vegetable at the same time, and that as soon as one has commenced another immediately follows, so that while a portion are leaving the vegetable and holding it firmly to the plate, others are commencing, preventing by this arrangement the vegetable from rolling or dodging, and keep it continually in contact with the knives, thereby cutting with greater rapidity with less power, and leaving the cut vegetable in a more desirable shape for mastication than any machine now in use."

150. For an *Improvement in Operating Valves for Steam Engines;* Samuel R. Wilmot, Watertown, Connecticut.

Claim.—"The valve motion for operating the valves of steam engines, and consisting essentially of a twisted traverse rod of a traveling slide, and of the stops which limit the turning of the slide, or their equivalents."

151. For an *Improved Method of Raising Water;* Daniel K. Winder, Cincinnati, Ohio.

Claim.—"The arrangement and combination of annular reservoir, with the plunger, tube, flexible pipe, valves and cock."

152. For an *Improvement in Boot Crimping Machines;* J. G. Baker, Jr., Assignor to self, and Charles Bradfield, Philadelphia, Pennsylvania.

Claim.—"The combination of the swiveled stay-rods, with their cross-heads and thumb-screws, when arranged with the former for the purpose of facilitating the removal of the finished boot front, and introduction of another piece."

153. For an *Improved Sash Fastener;* Thomas Floyd, Assignor to self, and G. H. Merkline, Chambersburg, Pennsylvania.

Claim.—"The triangular or catch lever, and thumb lever, in combination with the cylinder, the follower with piece attached, and spring."

154. For an *Improved Tile Machine;* Junius Foster, Assignor to self, John Herbold, and George Kuhn, Brooklyn, New York.

"The nature of my invention consists in supplying clay to a pair of rollers or rolling die, by means of a plunger that presses into and through said rollers, and then said rollers remain stationary at the time the plunger recedes to take a fresh supply of clay from the hopper, and simultaneously the tile is cut off while stationary, ready to be taken away for drying."

Claim.—"The combination of the reciprocating plunger, with the rollers, slide or trough, and knife or wire, when the said parts are arranged for joint operation."

155. For an *Improvement in Curtain Fixtures;* Lewis B. Cushman, Assignor to self, Henry W. and Henry Safford, Philadelphia, Pennsylvania.

Claim.—"The use of the lever, when the said lever is caused to operate upon the bracket in supporting a window curtain by means of the upward strain of the cord."

156. For a *Varnish Can;* Alonzo Marshall, Assignor to Benjamin Marsh, Newark, New Jersey.

Claim.—"Connecting the two vessels by a pipe."

157. For an *Improved Mode of Securing to each other the Panels of Field Fences;* C. P. Garlick, Amador, Minnesota Territory, and G. M. Blackstone, Mainville, Ohio.

Claim.—"The combined uses of the mortises and wedges in the chair, when arranged with, and used for, connecting the lower part of the panels of the fence together."

FEBRUARY 24.

158. For an *Improved Keeper for Right and Left-Hand Door Locks;* Calvin Adams, Oak Hill, New York.

Claim.—"The use of a beveled keeper, when employed in connexion with a double-faced lock, having a blunt bolt, so that the lock may be used on a right or left-hand door, without changing any of its parts."

159. For an *Improvement in Hand Seed Planters;* John H. Bruen, Penn Yan, N. Y.

Claim.—"The thin broad extremity, or its equivalent, at the lower end of the rod, acting as a cam to open the blades, by giving said rod a partial turn with the hand. Also, in combination with the above, the arrangement of the seed distributor on the rod, whereby the seed is made to drop simultaneously, and only with the opening of the blades. Also, the star or coral shaped attachment of the rod, operating so as to insure the regular action of the seed distributor."

160. For an *Improvement in Hinges;* John David Browne, Cincinnati, Ohio.

Claim.—"Making one part of the bearings of a hinge concentric to the other part."

161. For an *Improvement in Grinding the Inner Surface of Cast Iron Kettles;* Christopher C. Bradley, Jr., Syracuse, New York.

Claim.—"The arrangement of the revolving shaft, vertical fans, and the grindstones, with respect to the kettle, when the grindstones operate upon successive portions of the kettle by a change of velocity in the shaft."

162. For an *Improved Cauterizing Syringe;* Erastus T. Bussell, Shelbyville, Indiana.

Claim.—"The combination of hollow plunger with cauterizing rod encased, and divergent spring fingers, with absorbent bulbous extremities, all connected with cylindrical tube."

163. For an *Improved File Cutting Machine;* Isaac H. Coller, Poughkeepsie, N. Y.

Claim.—"As an improvement on the mode patented by Conklin, Sidman, and Whritner, the jointed frames, for transmitting the graduated effect of the springs to the hammer, so that the rods holding said springs will not vibrate from the movement of the hammer. Also, the combination of the lever-jaws, with the spring tang holder."

164. For an *Improvement in Combining Hydrogen and Wood Gas;* Warren C. Choate and Charles N. Tyler, Washington, D. C.

Claim.—"Combining hydrogen gas with the gaseous products evolved from the dry distillation of wood."

165. For an *Improvement in many Chambered Rotating Breech Fire Arms;* Samuel Colt, Hartford, Connecticut; patented in England March 3, 1853.

Claim.—"Making the series of grooves to be acted upon by the driving pin, to rotate and hold the breech in a concavity in the rear end of the rotating breech."

166. For an *Improved Elastic Cap for Sealing Cans and Bottles;* Rhoda Davis, Brookhaven, New York.

Claim.—"A cap or cover for sealing vessels, composed of india-rubber."

167. For an *Improvement in Gig Mills for Napping Cloth;* Ernest Gessner, Aue, Saxony.

Claim.—"1st, The arrangement of the parts of the machine, whereby it combines the properties of napping the cloth while it is continually moving over the surface of the napping cylinder, of holding the cloth stretched in the direction of its breadth, of presenting the cloth to the napping cylinder in such manner that the face which receives the nap is exposed to view, and of operating on the cloth at several points of contact at the same time. 2d, The arrangement of the four guide rollers, so as to be simultaneously adjusted by screws, or their equivalents, applied to their bearings to bring the cloth into more or less intimate contact, or with a greater or less surface in contact with the napping cylinder."

168. For an *Improved Apparatus for Supplying the upper stories of Houses with Water;* Thomas Hanson, City of New York.

Claim.—"The combination of a hydraulic engine, with, and interposed between, the

supply pipe from the street main, receiving water from a head, and the house pipe or pipes, and cock or cocks, for supplying water to the lower story or stories of a house by the force of the said head, and the pump operated by the said engine, and receiving water from the same head, discharging it into a reservoir or reservoirs for the supply of the upper stories of the house."

169. For an *Improvement in Marking Slates;* John W. Hoard, Providence, Rhode Island.

Claim.—"I do not claim liquid quartz itself for producing indurative surfaces for marking upon: but I claim it as the vehicle for manufacturing artificial marking or writing slate, when combined with oxyd of zinc, as a drying anti-deliquescent and coloring substance."

170. For an *Improvement in Casting Skeins for Wagons;* Andrew Leonard, Kenosha, Wisconsin.

Claim.—"The method of moulding and casting thimble skeins, and other hollow conical castings in a vertical position from whole patterns, leaving their own cores of green sand, which were moulded in the hollow of the patterns, around one end of long core bars, so arranged and combined with the cores and with the solid sand in the flask, as to have the other end of the same bars sustain the core, or to render them adjustable by hand, after the patterns are withdrawn and the mould completed, and of thus ensuring the true position of the cores in the centre of their moulds, and making the casting perfectly true and seamless direct from the sand."

171. For a *Photographic Glass-holder;* Joseph Longking, Township of New Windsor, New York.

Claim.—"A photograph holder, composed of antimony, tin, and lead, alloyed in the proportions set forth."

172. For an *Improvement in the Manufacture of Iron and Steel;* Joseph C. Martien, Newark, New Jersey.

Claim.—"Subjecting the molten iron to the action of atmospheric air, steam, or other gaseous body, or chemical agents, in any form capable of evolving oxygen or other purifying gas, in such manner as to cause the air, steam, or other solid liquid or gaseous body, to impinge upon, penetrate through, or search among, the metal while it is flowing or in a state of transit through a trough or conductor, or other place."

173. For an *Improved Calk for Horse Shoes;* Edward Maynard, Williamsburg, New York.

Claim.—"The conical or tapering body of the calk, fitting a corresponding shaped hole in the shoe, in which it is retained by the screw, or its equivalent."

174. For an *Improvement in Iron Pavements;* Charles Mettam, City of N. York.

Claim.—"Casting each block or plate, with a number of hooks standing out laterally from below the general level of the bottom thereof, and turning upwards in the form of vertical tenons, and with a corresponding number of mortises in the lower faces, so that when the plates are laid together, the vertical tenons of one block or plate enter mortises in adjacent ones, and the mortises receive tenons of adjacent ones, while the laterally projecting portions of the blocks or plates make them mutually supporting."

175. For an *Improvement in Steam Boilers;* Jason J. Palmer, Flushing, New York.

Claim.—"The particular arrangement of the flues close to the fire shell of the boiler, and admitting only a thin but continuous sheet of water between them and the fire shell—this thin sheet of water also connecting freely at top and bottom, with the main body of water in the boiler—by which arrangement a more rapid and complete circulation is produced, this thin sheet of water being constantly forced towards, and in contact with, the sides and crown of the fire shell, *i. e.*, the hottest parts of the boiler, and thus heated more rapidly and made to circulate the faster. Also, the arrangement of the perforated plate, it being interposed between the furnace and low exit into the smoke box or stack."

176. For an *Improvement in Cordage Machines;* James Pine, Hoosick Fall, N. Y.

Claim.—"1st, The additional flyers carrying the stretching rollers, arranged relatively to the main flyers, and deriving motion in the same direction as the said flyers, but at a less velocity, and operating to stretch the strands after they have received the usual twist, and to impart an additional twist to compensate for the reduction of twist

by stretching. 2d, The device for producing an uniform tension on the strands by friction upon the strand bobbins, consisting of the elastic curved lever, or combined lever and spring, attached by a fulcrum pin to the flyer-frame, and operating on one head of the bobbin, and upon the surface of the outer coil of yarn or strand on the bobbin."

177. For an *Improved Saw Filer;* Archibald Robbins, Alanson Shewman and L. R. Bigelow, Watkins, New York.

Claim.—"The combination and arrangement of the sliding carriage, the index-wheel, arc adjuster, and guide frame."

178. For an *Improvement in Floating Sectional Dry Docks;* John Seely, Buffalo, New York.

Claim.—"1st, The combination of the conducting pipe with the tubular hinges and sectional dock. 2d, The combination of the parallel braces (turning upon joints) with the floating docks and the wheel pit."

179. For an *Improved Saw-Set;* Joseph D. Spiller, Concord, New Hampshire.

Claim.—"Combining the gauge and bearing screw in one movable frame, applied to the lower jaws, and furnished with a set-screw."

180. For an *Improvement in Grain Separators and Straw Carriers;* Cornelius Van Derzee, Albany, New York.

Claim.—"The method of agitating and moving the straw, for the purpose of separating the grain from it by rungs of spokes, rotating in connexion with each, or in reference to each other's movements."

181. For an *Improvement in Manufacturing Ribs for Cotton Gins;* John W. Webb, Cotton Valley, Alabama.

Claim.—"The new manufacture of cotton gin ribs, that is to say, ribs of cast iron, with two places chilled upon them in casting, while the rib is so formed that the ends may be reversed in the same breast of the gin, so that when one chilled part of the rib is worn out, the other may be brought to the working point of the gin saw, and thus effect an important economy in the construction of cotton gins."

182. For a *Solar Camera;* David A. Woodward, Baltimore, Maryland.

Claim.—"Adapting to the camera obscura a lens and reflector, in rear of the object glass, in such manner that it is made to answer the two-fold purpose of a camera obscura and camera lucida."

183. For an *Improved Method of Hanging the Sieves of Grain Separators;* Benjamin Wright, Hudson, Michigan.

Claim.—"The use of an adjustable pin and hooked stop plate."

184. For an *Improved Metallic Lathing;* Wm. E. Worthen, City of New York.

Claim.—"Corrugated metal, provided with tongues slit out of the body thereof, and bent away from their original position, and constituting as a whole an article to be used in building. Also, such tongues, formed substantially in such a manner, on and out of corrugated metal when they are dished or concaved."

185. For an *Improvement in Shoving-poles for Steamboats;* D. Cumming, Jr., Assignor to D. Cumming, Sr., Mobile, Alabama.

Claim.—"The combination of a shoving-pole or rod directly with the piston of a portable or movable steam cylinder."

186. For an *Improved Device to operate the Mandrel-Cutters in Turning Tapering Sticks;* Peter H. Niles, Assignor to self, Nehemiah Hunt, Ralph C. Webster, and Alfred Douglas, Jr., Boston, Massachusetts.

"The invention consists, firstly,—of a hollow arbor, which is capable of being revolved in suitable bearings, to one end of which a chuck is attached, which carries a cutter and also three movable radial jaws, whose office is to steady the work. 2d, Of a cam, which moves the jaws towards and from the axis of the arbor, while the work is passing through the said arbor. 3d. Of a chain or belt, provided with projections or dogs, for carrying the work to the cutter."

Claim.—"The method of operating the cutters of a revolving cutter-head, viz: by means of the springs, inclined planes, and the sleeve operated by a cam."

187. For an *Improvement in Preparing Alkaline Silicates;* John M. Ordway, Assignor to the Roxbury Color Chemical Manufactory, Roxbury, Massachusetts.

Claim.—"The manufacture of soluble silicates of soda or potash, from the sulphates of soda or potash, by fluxing the same with silica and deoxidizing agents."

Re-Issues for February, 1857.

1. For an *Improvement in Mode of Driving Reciprocating Saws;* Isaac Brown, Baltimore, Maryland; patented July 14, 1853; re-issued Feb. 3, 1857.

Claim.—"The mode of applying the power of the engine to the saw or frame, without being permanently connected therewith, so that the piston shall be in a great measure relieved from any lateral motion which the gate may have, which causes it to bind or cut in the cylinder. Also, driving one or more saws between two cylinders, as well as driving one or more saws on each side of a single cylinder, and the self-adjustable piston-rod, or the self-adjustable slides, which accomplish the same result."

2. For an *Improved Raking Attachment for Reapers;* Moses G. Hubbard, Penn Yan, New York; patented September 2, 1856; re-issued Feb. 3, 1857.

Claim.—"The combination of the jointed rake arms, with the disk by which the arm is actuated, when the above parts are constructed and arranged for joint operation."

3. For an *Improvement in Machines for Pressing Bonnets and Bonnet Frames;* Wm. Osborn, Louisville, Kentucky; patented August 19, 1856; re-issued Feb. 17, 1857.

Claim.—"Pressing the whole of a bonnet or bonnet frame, including the flaring face piece, side crown, and tip, at one operation, by dies, whether said bonnet or frame be formed of one or of several pieces, and irrespective of the particular shape of the bonnet or frame. Also, forming the side crown and flaring face piece of a bonnet frame in one piece, or at one operation."

4. For an *Improvement in the Manufacture of Hosiery;* Wm. H. McNary, Brooklyn, New York; patented December 23, 1856; re-issued Feb. 17, 1857.

Claim.—"The production of the heels and toes of hosiery, by knitting a piece of spherical or other suitable form, on the cylindrical or straight portions of the leg or foot, by any mode of operation in which the stitches are dropped or left upon the needles and taken up again, whereby the whole of the leg and foot is enabled to be produced by a continuous operation of the machinery or devices employed."

5. For an *Improved Machine for Making Clothes Pins;* George W. Parker, Fitzwilliam, New Hampshire; patented March 18, 1856; re-issued Feb. 17, 1857.

Claim.—"1st, The use of holes in a wheel, or of tubes secured to a wheel, and into which the pieces of cloth are fed, and are thus retained in, and moved forward to, the right position to be acted upon by the lathe, saw, or bit. 2d, The sliding or vibrating lathe and tail-block, whereby the pieces of wood to be turned are carried forward to the action of the cutters or chisels. 3d, The cutters or chisels, in combination with the lathe. 4th, A holder, to hold the pieces while being sawed or bored, the succeeding piece forcing the preceding one out of the holder, and it drops between the holder and saw or bit; and whether the holder be movable or stationary, the saw or bit being made to move to and from the holder, or the holder be made to move to and from the saw or bit. 5th, a saw or bit, either movable or stationary, in combination with the holder. 6th, A punch, or its equivalent, to force the pieces into the holder."

6. For a *Bituminous Ground for Photographic Pictures;* V. M. Griswold, Lancaster, Ohio; patented October 21, 1856; re-issued Feb. 24, 1857.

Claim.—"'Sensetized bitumen' prepared for the purpose of taking photographic impressions on paper, metallic sheets, or other structure."

7. For an *Improvement in the Mode of Constructing a Combined Cauldron and Furnace for the use of Agriculturists and others;* Jordan L. Mott, Mott Haven, New York; patented Dec. 1, 1840; extended Dec. 1, 1854; re-issued Feb. 6, 1855; re-re-issued Feb. 24, 1857.

Claim.—"Combining a cauldron with a small, square, or rectangular box stove of

less area than the cauldron, by spreading out the upper part of the box stove to a circular form to surround the cauldron by a flue space. Also, making the casing to form a flue space around the cauldron, by the elevating and spreading the plates of the stove, in combination with sectional side pieces."

8. For an *Improvement in Looms for Weaving Pile Fabrics;* Erastus B. Bigelow, Boston, Massachusetts; patented November 15, 1853; re-issued February 24, 1857.

Claim.—"1st, The method of constructing and operating the pincers, or other equivalents, for successively operating the pile, so that they shall carry said pile wires forward to the fell of the cloth, and hold them in position with their proper edges upwards until they are otherwise secured. 2d, Constructing the pincers for successively operating the pile wires with grooved jaws opening and closing in a line with the pile wire, and within advance of the lathe. 3d, The employment of a support or guide to successively receive the inner ends of the pile wires as they are drawn from the cloth, and carry them to the position where they are to be introduced into the shed of the warps, and guide them therein. 4th, The employment of long horizontal guides to guide the pile wires as they are being inserted in the shed of the warps. 5th, Holding the pile wires and guiding and adapting the pincers, or their equivalents, to a suitable position to engage therewith. 6th, In combination with the pile wires, a bar or guide, which shall successively press against said pile wires to keep them in a proper position during the operation of cutting the pile. 7th, The method of applying the tension weight and brake directly to the whip roller by means of the arms."

Design for February, 1857.

1. For *Wood Stoves;* A. C. Barstow, Providence, Rhode Island; February 17, 1857.

Claim.—"The new design for a stove, consisting of the ornamental configuration."

MARCH 3.

1. For an *Improvement for Sustaining Friction-rollers in Ship Blocks;* John Allender, City of New York.

Claim.—"The pieces placed between the rollers, in combination with the flanches, or their equivalents, to hold the rollers in position endwise, and permit them to revolve, thereby dispensing with the pivots and rings."

2. For an *Improvement in Casting Plates for Artificial Teeth;* Alfred A. Blandy, Baltimore, Maryland.

Claim.—"Moulding the plates of artificial teeth in such a manner as to obtain a perfect fit to the gums, and a correct 'articulation' of the teeth upon casting."

3. For an *Improvement in Compositions for Shuttle Drivers;* Samuel Boorn, Lowell, Massachusetts.

Claim.—"Composition to be used in the manufacture of the striker of a shuttle driver."

4. For an *Improvement in Sewing Machines;* Charles D. Belcher, Charleston, South Carolina.

Claim.—"The improvement on the patents of A. B. Wilson, consisting in the application of an unyielding brake to hold the loop upon the revolving hook, and imparting a positive movement thereto, in such a manner as to separate it from, and bring it to, the periphery of the hook at the proper moment."

5. For an *Improved Pen and Pencil-Holder;* George Hunt Byron, Governor's Island, New York.

Claim.—"The attachment of the handle of the holders to a diagonal expanding frame, and the general arrangement. Also, the handle and the arms, working by pins in slots in the attached holders, and secured by thumb-screws to the handle. I do limit myself to any number of holders, which may consist of any required number. Also, its application by attaching pens known as 'music pens,' instead of the ordinary writing pens, for ruling several staves of music at one operation."

6. For an *Improved Hand Stamp;* Leonard Bailey, Winchester, Massachusetts.

Claim.—"Arranging an ink fountain and its discharging roller at the foot of the slider, and between the same and the type or printing plate, and so as to be movable. Also, arranging the forked lever of the inking roller, with respect to the slider, so that while the palm of a person's hand is placed on the top of the slider, one or more of the fingers can operate said lever or the upper arm thereof, in a manner to move the inking roller backwards against the type, and into a position to come in contact with the fountain roller, when the slider is next depressed."

7. For an *Improvement in Sewing Machines;* Joseph W. Burnham, Hartford, Conn.

Claim.—"The employment on sewing machines of the mechanism, so as to cut or clip the thread on the underside of the work."

8. For an *Improvement in Trip Hammers;* Henry Bushnell, New Haven, Conn.

Claim.—"The use of the male and female wheels, having a portion of the surface of either one of them removed, so as to permit the hammer to drop freely."

9. For an *Improvement in Washing Machines;* Richard Collins, Chicopee, Mass.

Claim.—"Combining with, and arranging in, the vibratory dasher, one or more soap receptacles or chambers, each provided with an aperture of discharge, and a stop-cock or faucet, or the equivalent therefor."

10. For an *Improvement in the Mode of Lubricating Fire Arms;* Samuel Colt, Hartford Connecticut.

"The nature of my invention consists in applying lubricating matter in the barrels of fire arms, after the ball has been inserted, whether such lubricating matter has been applied to the outer surface of the ball or the inner surface of the barrel, by means of which the fouling of the barrel by the ball is effectually prevented, and the passage of the ball in the discharge greatly facilitated, while at the same time the lubricating matter will be prevented from reaching the charge of the powder."

Claim.—"The method of applying oil, or other lubricating matter to the outer surface of the ball, or as the equivalent to the bore in close proximity with the ball, after the ball has been inserted by means of an instrument having a reservoir of liquid lubricating matter, in combination with a valve, or other equivalent means for discharging the required quantity of lubricating matter."

11. For an *Improvement in Churns;* E. P. and J. A. Cowles, Oakfield, New York.

Claim.—"The shafts, with collars and wheels, in combination with springs."

12. For an *Improved Hand-Printing Press;* Nathaniel L. Chamberlin, West Roxbury, Massachusetts.

Claim.—"1st, The method of hanging and balancing the impression roll. 2d, The method of adjusting the impression roll to increase or diminish the pressure given and adapt it to the size of the form and the height of the type or block."

13. For an *Improved Machine for Cutting Paste-board for Boxes;* Eliezur E. Clarke, New Haven, Connecticut.

Claim.—"1st, The method of attaching and adjusting the cutters, in combination with the main cylinder. 2d, The combination of the spring clamps with the main cylinder and cutters."

14. For an *Improvement in Sheep Shears;* Edward G. Chambers, Bucyrus, Ohio.

Claim.—"The fixed plate stock, combined with the bifurcated handle of the vibrating cutters."

15. For an *Improvement in Harvesters;* Stillman A. Clemens, Rockford, Illinois.

Claim.—"The method of operating the sickles of harvesters by means of a catch-wheel, a spring and a recoil cushion, connected, combined, and attached."

16. For an *Improvement in Potato Diggers;* Paul Dennis, Stillwater, New York.

Claim.—"In combination with the diggers constructing the separator, so as to form an irregular undulating surface for the potatoes to fall upon."

17. For an *Improved Method of Suspending Wind-Wheels in Self-revolving Adjusting Frames;* Joseph de Sendzinner, South Oyster Bay, New York.

Claim.—"Suspending the wind-wheel within a revolving frame."

18. For an *Improvement in Making Tire for Railway Car Wheels;* James Evans, Portsmouth, Ohio.

Claim.—"The use of the rings, in connexion with the segments of iron, the same being cut, and piled, and prepared for forging, for making tire for railroad car wheels, locomotives, and other purposes."

19. For an *Improved Circular Sawing Mill;* Philander Eggleston, Mobile, Alabama.

"The invention consists in suspending the log to the carriage, or attaching it to the under side of the carriage by means of hooks and dogs, and also the two saws and feed movement, when used in connexion with the log suspended to the carriage."

Claim.—"1st, Suspending the log to the carriages by means of the bars, and arranged with the screw-rods and shafts, whereby the log may be firmly dogged or secured in proper position, and also adjusted, or elevated, or depressed to the desired position or height. 2d, Suspending the log from the carriages, as shown, in any proper mannner, in combination with the two saws and the feed movement, composed of the shafts, with their respective pulleys, and belts, and the clutch."

20. For an *Improvement in Machines for Harvesting Standing Corn;* James H. Frampton, Hopewell, Ohio.

Claim.—"The body, so arranged that it may be operated to discharge the stalks, in combination with the rods placed in said body, and provided with curved ends or griping arms."

21. For an *Improvement in Chronometer Escapement;* James Fulton, Louisville, Kentucky.

Claim.—"The combination of two levers, in such a way that one spring may perform the offices by acting on both of them."

22. For an *Improvement in Bridge Trusses;* Albert Fink, Parkersburg, Virginia.

"My improvement consists in the use of an auxiliary truss, between the main supports of a truss, commonly known under the name of Howe's truss."

Claim.—"The use of an auxiliary truss, which is to consist of the lower part of the counter-brace, and of a piece placed between the two main braces, independent of these braces."

23. For an *Improvement in Seed Planters:* Firman Goodwin, Astoria, New York.

Claim.—"Arranging the seed hoppers and seed cylinders, and the mechanism which operates the seed cylinders, upon movable bars, in combination with the double crank and frame."

24. For an *Improvement in Harvesters;* Lewis W. Harris, Waterville, New York.

Claim.—"1st, In combination with the alternately projecting lags, the rocking shafts, with their toe pieces, cranks, and connecting rod, for the purpose of operating the cutters. Also, hanging the shafts in the hinge pieces, when said hinge pieces are put within the control of the conductor, by means of the rods and treadle, or their equivalents, so that he may, from his seat, throw the cutters into and out of gear."

25. For an *Improved Hand-Stamp;* Horace Holt, Winchester, Massachusetts.

Claim.—"The combination of a detached lever, with its toe pieces for inking and taking the impression, when said inking and impressing devices are returned to their places by springs."

26. For an *Improvement in Machines for Making Axes;* Charles Hutchins, East Douglass, Massachusetts.

Claim.—"The preparation of the bar or block of iron, by longitudinal rolling between rolling dies, operating to form it with a projection on one face into the middle of its length, and two projections on the opposite face, one at each end, in combination with the cross rolling between segment dies, under a mode of operation to reduce the thickness of the cheeks towards the edges, and to the required swell on the edges of the cheeks."

29. For an *Improved Screw Wrench;* B. F. Joslyn, Worcester, Massachusetts.

Claim.—"A hammer shank, with a thread on both edges fitting into a nut, when combined with the other parts of the wrench."

28. For an *Improvement in Weavers' Shuttles;* Lucius J. Knowles, Warren, Mass.

"My improvement or invention consists in a means of causing a loom to stop its motion or weaving operation, on the breakage of the thread leading from the bobbin of the shuttle."

Claim.—"The combination of the tilting lever, the inclined wires (or the equivalent of the latter), and a spring cam, or means essentially the same as said spring cam, whereby in case of breakage of the thread from the shuttle, while the latter is in motion across the race beam of the lay, the cam or contrivance to operate the protector may be caused to so act with or against such protector, or its equivalent, that it shall be made to produce stoppage of loom as stated."

29. For an *Improved Raker for Reaping Machines;* Caleb Lee, Knox Township, Ohio.

Claim.—"The two spring latches working upon the arm, in combination with the pointed lever, the latches being notched to receive the same; and both the lever and latches being arranged so as to be acted upon alternately by pins, to raise or lower the rake and hold it in either position as required."

30. For an *Improved Basin Cock;* Robert Leitch, Baltimore, Maryland.

Claim.—"The arrangement of the loose stop-piece, constructed with a male screw thread on the periphery, and the means for operating it vertically without turning, by the fixed square on the stem, and a corresponding female screw-thread, or its equivalent, in the rotating globe of the cock."

31. For an *Improvement in Machines for Husking Corn;* Wm. Lewis, Seneca Falls, New York.

Claim.—"The bar, knife, bar or hammer, and stop, in combination with the clearing rod, when the whole are arranged to operate conjointly."

32. For an *Improved Photographic Plate-holder;* Wm. and Wm. H. Lewis, City of New York.

Claim.—"1st, Constructing the hollow base and hub of the cap-plate in such a manner as to receive the friction spring, screw, and cap, for regulating the power with which said plates are clamped together. 2d, Regulating the force with which the spring tends to clamp any glass or holder between the jaws, and by means of the set-screw. 3d, The beveled adjustable bars on the jaws, to support the glasses, plates, or holders, with their upper surface at the desired height above the upper edges of the said jaws."

33. For an *Improvement in Mastic Roofing Compounds;* Charles R. Milks, Detroit, Michigan.

Claim.—"The composition for roofing made up of the ingredients."

34. For an *Improvement in Machines for Husking Corn;* John Massey, Buffalo, New York.

Claim.—"The tapering tubular burr, for the purpose of removing the husks from the corn."

35. For an *Improvement in Curtain Rollers;* Purches Miles, Hartford, Conn.

Claim.—"The combination of the toothed flanched pulley, the endless eyelet band, and the friction spring with the roller."

36. For an *Improved Shingle Machine;* H. D. McGeorge, Morgantown, Virginia.

Claim.—"In combination with the saw and carriage, the rocking bed for determining and adjusting the bolt to the thickness and taper of the shingle to be sawed."

37. For an *Improvement in Machines for Composing Types;* Wm. H. Mitchel, Brooklyn, New York.

Claim.—"The manner of dropping one type at a time from the lines of types in the conductors, by the combined operation of the pushers, stop, and fingers. Also, the composing wheel when used in connexion with the inclined chute or conductor and fence, on the lower side only of the inclined composing wheel. Also, the compositor's grab formed in the curved shape."

38. For an *Improvement in Machinery for Grinding Card Cylinders;* Jonathan Parker, Biddeford, Maine.

Claim.—"The combination of the stop motion or mechanism, or the feed mechanism, or that which produces the reciprocating traverse motion of the grinder."

39. For an *Improvement in Sewing Machines;* Samuel F. Pratt, Roxbury, Mass.

Claim.—"Producing successive corrugations or folds in the cloth, for the purpose of feeding the cloth for the production of the stitches. Also, the combination of the lifter spring, the nipper spring, the rod, and flattening spring, they operating together and upon the cloth."

40. For an *Improved Machine for Beveling and Jointing Staves;* Erastus M. Pitman, Warren County, Virginia.

Claim.—"The combination of the reciprocating plane, having reversed bits and the motion referred to, and the carriage with the inclined ways."

41. For an *Improvement in Generating Steam;* Charles F. Pond, Hartford, Conn.

Claim.—"The method of generating steam from water, introduced in numerous fine jets, and thrown upon heated metallic surfaces, when this is combined with the heating of the said metallic surface on which the jets of water are to be thrown, to be evaporated by the contact of steam, generated in a separate boiler, connected therewith, for circulation and other purposes."

42. For an *Improvement in Centrifugal Friction Clutch;* Rensselaer Reynolds, Stockport, New York.

Claim.—"The employment in the combination of the sector friction brakes, sliding radially in the wheel or pulley which rotates before the clutching takes place, and usually termed the loose pulley, that the other wheel or fast pulley may be clutched by the friction of the brakes due to the centrifugal force generated by the rotation, and by which they are forced onward against the inner periphery of the wheel to be clutched, thereby clutching the parts by a force no greater than that due to the friction produced by the centrifugal force under the determined proportions, weight, and rotative velocity of the friction brakes."

43. For an *Improvement in Locks;* J. Christian Riethmüller, Pittsburgh, Pennsylvania.

Claim.—"The peculiar arrangement of the tumbler plates in the box, viz: the tumbler plates projecting and receding alternately sidewise, their guiding grooves in the box being made accordingly deeper and shallower alternately, and also separating the tumbler plates by a small space—this whole arrangement of the plates being for the purpose of allowing each spring to act on its respective tumbler plate freely, without interfering with or disturbing the free play and action of the plates or springs adjoining. Also, the providing of one of the tumbler plates with the tongue and the recesses in the bolt tumbler, operating together for the purpose of securing the bolt tumbler in its position when the lock is in its locked or unlocked state. Also, the combination of the key and bit plates."

44. For *Improved Soap Mixtures;* Isaac Roraback, Parish of Caddo, La.

Claim.—"The compounding of them in such proportions as to form a solid of suitable consistency, which I believe excels any other soap in its suitableness for cleansing clothes of every description, and for toilet purposes generally, as well as in point of cheapness and convenience, and dispatch with which it is made."

45. For an *Improvement in Washing Machines;* Louis C. Rodier, Detroit, Michigan.

Claim.—"The revolving cylinder composed alternately of flanches and spaces opposite said flanches, in combination with the jacket."

46. For an *Improvement in the Manufacture of Tin Pans;* E. F. Parker and J. Smead, Proctorsville, Vermont.

Claim.—"A milk pan with a struck up bottom, and united to the side."

47. For an *Improvement in Projectiles;* Malcom Shaw, Sandwich, Massachusetts.

Claim.—"The improvement upon this kind of shell whereby I am enabled to use melted metal as the incendiary material, and which consists in lining the chamber of the incendiary material with some non-conducting and refractory substance, such as

pipe clay, black lead, &c., and perforating the iron to allow the escape of the gas there from, thereby providing against premature explosion, and retaining the heat in the melted metal."

48. For an *Improved Mould Candle Machine;* Benjamin D. Sanders, Holliday's Cove, Virginia.

"My improvement has for its objects the manufacture of stearine, and other mould candles, with greater celerity, convenience, retention at the proper stretch, and exactness as regards central position of the wick in the mould, and improves the candle made."

Claim.—"Causing the wick centering slide to stretch and hold the wick in the mould by its operation on the wick when bent over the slide, and said bent portion of the wick having the drawn candle attached or suspended to it in rear of the notched edge of the slide."

49. For an *Improvement in Projectiles for Rifled Cannon;* John M. Sigourney, Watertown, New York.

Claim.—"Recessing the cylindrical part of cylindro-conical shot and shells, in such a manner that the contact of said shot and shells with the bore and grooves of the gun be confined to the projecting ribs and belts, which belts and ribs are finished to fit the bore and grooves with precision."

50. For an *Improved Method of Operating the Supply and Discharge Valves of Hydraulic Engines;* Homer H. Stuart, City of New York.

Claim.—"Arranging the four flap valves on the rock-shaft to operate in the separate compartments of the two valve boxes placed at one end of the cylinder, and operating the same by means of the sliding arch piece, connected with arms at opposite ends of the said rock-shaft and driver by the vibrating arm of the rock-shaft of the main engine."

51. For an *Improvement in Cast Iron Pavements;* Charles J. Shepard, Brooklyn, New York.

Claim.—"Forming polygonal metallic paving blocks, with the inclines at the upper part of the straight sides, and with the projections to take the inclines of the adjoining blocks at unequal distances from the angle of said blocks."

52. For an *Improvement in Machines for Husking Corn;* Hiram Strait, Covington, Kentucky.

Claim.—"The toothed drum with its projecting saw or knife and cam, in combination with one or more ear holders."

53. For an *Improvement in Door Springs;* Leopold Thomas, Allegheny City, Penna.

Claim.—"The use of compound lever, in combination with the connecting arms and spiral springs, or their equivalent."

54. For an *Improvement in Melodeons;* Thomas F. Thornton, Buffalo, New York.

Claim.—"The combination of an extra adjustable lever with each of the push-down pins."

55. For *Improved Portable Fire Arms;* John Tilton and William Floyd, Rock House, Ohio.

Claim.—"The combination of the levers and spring and bridle, for effecting the simultaneous release of the trigger, and removal of the muzzle cover."

56. For an *Improvement in Guide Wheels for Railroad Cars;* John B. Wickersham, City of New York.

Claim.—"The guide wheels at the front and rear ends of the car, when combined with the grooved rail, and attached to the car."

57. For an *Improvement in Harvesters;* David Watson, Newark, New Jersey.

"This invention relates to a certain improvement in harvesters, wherein a peculiar provision is made for discharging the cut grain from the platform in sheaves or gavels."

Claim.—"The gate, in combination with the inclined endless apron and platform."

58. For an *Improvement in Machine for Hulling and Scouring Wheat, &c.;* Joseph Weber, Braysville, Indiana.

"The nature of my invention consists in the construction and arrangement of parts of a machine for hulling wheat and other grains, and for scouring the same in its own dust, performing the operation previously moistening the grain."

Claim.—"1st, The polygonal chamber, when made so that the grain will be turned over and over during its descent through the chamber, and be rubbed without being broken. 2d, The curved and notched arms, in combination with the polygonal chamber. 3d, The combination and arrangement of the polygonal chamber, curved and notched arms, and the smooth triangular arms."

59. For an *Improvement in Operating Valves for Steam Engines;* Norman W. Wheeler, Cincinnati, Ohio.

Claim.—"1st, Actuating the release valves of a steam engine by means of steam pressure derived from the working cylinder, and released therefrom by the passage of the working piston over and beyond appropriate ports, when the receiving valves are actuated by other means. 2d, Actuating the receiving valves of such engine by means of the differential pressure of steam flowing into the steam cylinder, when the resistance to be overcome arises in whole or in part from steam pressure upon one of a pair which are connected together. 3d, Opening the exhaust passages into the cylinder near each end thereof, but within the stroke of the piston. 4th, Connecting puppet valves together in pairs, so that steam pressure upon the one which is closed will hold its fellow open."

60. For *Improved Devices for Aging Liquors;* Anson and A. Spencer Wolcott, East Bloomfield, New York.

"This invention relates to the improvement of alcoholic liquors, by imparting to them what is termed age."

Claim.—"The employment of swinging shelves, or their equivalents, for the purpose of gently agitating the liquors while they are exposed to a moderate heat."

61. For an *Improved Metallic Roof;* Wm. E. Worthen, City of New York.

Claim.—"A roof composed of U shaped metallic beams, which themselves are a portion of the covering, and of arching metallic plates, plain or corrugated, connecting said beams and composing the rest of the covering."

62. For an *Improvement in Back-plates for Fire Places and Grates;* Fountain E. Pitts, Nashville, Tennessee.

"My invention consists in arranging a grating, the bars of which are angular in the throat of a chimney, in such manner as to cause the smoke to pass through it; the peculiar form and arrangement of the bars being such as to arrest much of the heat that would otherwise pass up the chimney, and radiate it into the room."

Claim.—"The back-plate for fire places and grates constructed with the series of angular ridges, furrows, and slots."

63. For an *Improvement in Reflectors for Locomotive and other Lamps;* Isaac Carleton, Brooklyn, New York, Assignor to John Wyberd, Baltimore, Maryland.

Claim.—"The air tight glass cylinder passing through the reflector, in combination with the glass, hermetically sealing the mouth of the reflector."

64. For an *Improvement in Mastic Roofing Materials;* Nathan A. Dyar, Assignor to self and Seth D. Woodbury, Lynn, Massachusetts.

Claim.—"The employment of sulphuric acid (or an acid having a similar effect,) in the treatment of substances or compositions containing hydro-carbon."

65. For an *Improvement in Fluxes for Treating Alloys;* Elie Mowrice and Jules Francois Edward Vallent, Paris, France, Assignors to Henry Migeon, City of N. York; patented in France December 30, 1854.

Claim.—"The employment, in combination of the non-metallic substances (or substances having equivalent properties), in the refining of copper and its alloys, whereby the essential qualities specified are imparted to the copper or its alloy."

66. For an *Improvement in Seeding Machines;* Lewis B. and Henry A. Myers, Assignors to selves and Isaac Myers, Massillon, Ohio.

Claim.—"Measuring and distributing grain seeds or fertilizers by two or more piston heads, and one rod, or their equivalent, operating in and out of an aperture."

67. For an *Improvement in Ships' Steering Apparatus;* John B. Holmes, Assignor to John R. Pratt, City of New York.

Claim.—"1st, The arrangement of a pinion on the end of the tiller working into a stationary curved rack attached to the deck of the vessel, in connexion with a friction roller working against a smooth stationary surface to prevent the rudder from being pressed out of its place. 2d, The arrangement of attaching the pinion to the end of the tiller, in connexion with a beam, in such a manner as to be able to move said pinion further into a stationary rack by the action of said lever, for the purpose of producing a friction sufficient to hold the rudder thereby in any desired position, at the same time to lock the gearing to prevent any back lash on the steering wheel."

68. For an *Improvement in Ships' Capstans;* John B. Holmes, Assignor to John R. Pratt, City of New York.

Claim.—"The vertical recesses and welps extending the whole length of the barrel of the capstan, and allowing of two or more turns of the cable around the capstan."

69. For an *Improved Machine for Swaging Iron;* Junius Foster, Assignor to John Herbold, George Kuhn, and Junius Foster, Brooklyn, New York.

Claim.—"The adjustable block and rollers, and set on and moved by the lever, when combined with the pattern and flanch."

70. For an *Improved Nautical Alarm;* Edward L. Seymour, Assignor to James G. and Charles Wright, and Henry I. Geyer, City of New York.

Claim.—"The combination of frame, rods, hammers, axles, springs, pendulum, levers, and gongs or bells, to be placed upon buoys, floats, or vessels of any kind, for the purpose of causing alarm, and giving warning of rocks, shoals, or other dangers upon the coasts or at sea; and I do not mean to confine myself to any particular materials in the construction of the same, nor to the placing of the ring, levers, and springs, above or below the centre of oscillation, but to vary the position of the same, and of the gongs, and their number, as I may deem desirable."

71. For an *Improved Machine for Reducing and Smoothing Boards to uniform thickness;* Tristram D. Knight, Charleston, Tennessee.

"It is the main object of my invention to secure all the advantages resulting from the efficiency of the rotary cutter, its simplicity of construction, its cheapness, and its durability, and at the same time to finish the lumber with a plane surface."

Claim.—"The combination of the reducing saw, with the finishing grinder."

72. For an *Improvement in Pointing and Threading Screws;* Daniel M. Robertson, Manchester, New Hampshire.

Claim.—"A pointing tool, arranged in connexion with one or a series of threading tools, and traversed slower than the threading tools, and so far in advance of them as to form the point of the screw-blank, and prepare it for the threading tools; and I make this claim whether the pointing tool is traversed by the devices described, or by such other devices as will answer the purpose. Also, the plate or guide when made to traverse, whether it is operated by the devices described, or such others as will answer the purpose."

MECHANICS, PHYSICS, AND CHEMISTRY.

Address before the Institute of Mechanical Engineers, Sept. 17th, 1856.*

By Joseph Whitworth, Esq., President.

At a Special General Meeting of the Members held in Glasgow, Joseph Whitworth, Esq., President, in the Chair,—after the reading by the Secretary, of the minutes of the last General Meeting, the President delivered the following opening address:—

Gentlemen,—This being the first time I have taken the Chair since you did me the honor to elect me your President for the present year, I propose to address you shortly on a few topics more or less connected

* From Newton's Lond. Journ. of Arts and Sciences, Feb., 1857.

with our profession of mechanical engineering. But first, let me express my gratification, and I am sure that of my fellow-countrymen, in thus meeting our northern friends in this important city of the mechanical arts. Formerly, it was said of the Scotch mechanic, that once south, he never crossed the Tweed a second time; but the science with which we are so immediately connected has so shortened time and distance, that those circumstances are changed; for now he no longer has occasion to bid good-bye to his native land, but, thanks to railways, the penny post, and the electric telegraph, can keep up his family connexions, and return occasionally to see those who are dear to him, and to enjoy the scenes of his early recollection.

The city of Glasgow is peculiarly interested in the mechanical arts, for the minerals for making iron are found in great abundance in this locality; indeed, it is to this neighborhood, more than to any other, that the world is indebted for the cheapest and most abundant supply of iron. Here, too, that metal is converted into a great variety of machinery. There are large manufactories of the steam engine—fixed, marine, and locomotive. Cotton manufacturing and various other kinds of machinery are also made here in considerable quantities. With such links of connexion amongst us, I trust that this, our first meeting in this city, may be the forerunner of many others, and that we shall add many valuable members to our institution.

With regard to the manufacture of malleable iron and steel, it was with great gratification that I read the account of Mr. Bessemer's invention, so beautiful and simple as apparently to leave nothing further to be desired in that part of the process. I need not tell you of what vast importance it must be to those who are more immediately connected with those branches of mechanics requiring nicety of workmanship, to have iron and steel of a better quality. I may mention, that in making rifle barrels for the experiments which I have undertaken for the government, one of the greatest difficulties I encounter, in attaining the degree of accuracy that I require, arises from the defects in the iron. What we want is iron of great strength, free from seams, flaws, and hard places. Inferior iron (with the use of other defective and improper materials) is, perhaps, the main cause of one of the greatest errors committed in the construction of whatever in mechanism has to be kept in motion. I mean the increase of size of the parts of a machine or carriage, in order to get strength, thereby adding weight until they are considered to be strong enough. In our vehicles of draft and carriages this is strikingly the case. Now this ought not to be. Lightness is the thing to aim at, and safety should be sought in the elasticity, form, and good quality of the material. Should a carriage be found to twist and get out of form, that would be a proof of its being too light. But to prevent a carriage breaking down by increasing the size of its parts, and thereby adding weight, is mechanically wrong. Indeed, it is quite distressing to see the enormous weight of our carriages, particularly those drawn by animal power. It should be an axiom in mechanics, that whatever has motion, should be as light as circumstances will admit; and this applies equally, whatever the source of power may be, whether the motion is produced by human, horse, or steam power.

I would next call your special attention to the vast importance of attending to the two great elements in constructive machines,—namely, a true plane and the power of measurement. The latter cannot be attained without the former, which is therefore of primary importance; and its accomplishment is so easy and so simple as to leave without excuse any establishment neglecting to secure it. It is necessary to make three planes in order to obtain a perfect one, and cast iron is the best material generally to use. Whatever the size of the plane required, the tripod form is absolutely essential for its support; and the strengthening ribs must be placed with reference to the supports. I cannot impress too strongly on the members of the Institution, and upon all in any way connected with mechanism, the vast importance of possessing a true plane, as a standard for reference. All excellence in workmanship depends upon it. I may mention that it was at the meeting of the British Association, held in Glasgow in 1840, that I read a paper on the mode of producing a true plane, to which I would refer those desiring information on the subject.

Next in importance to a true plane is the power of measurement. I have brought with me, for your inspection at the close of the meeting, a small machine, by which a difference of length of the one-millionth part of an inch is at once detected. The principle is that of employing the sense of touch, instead of sight. If any object be placed between two parallel true planes, adjusted so that the hand can just feel them in contact, you will find, on moving the planes only the fifty-thousandth of an inch nearer together, that the object is distinctly tighter, requiring greater force to move it between them. In the machine before you, the object to be measured is the standard inch, in the form of a small square bar, both ends being true planes; and in this case, in order to measure with the utmost accuracy, a thin flat piece or bar is introduced, having its two sides made also perfect planes. This is placed between the inch bar to be measured and one of the end surfaces of the machine. This thin bar, which I name the gravity piece, is brought into contact with the two planes, so as just to allow it, on being raised, to fall by its gravity; and you will find that, by bringing the planes into closer contact by even the one-millionth of an inch, the gravity piece will be suspended,—friction overcoming its gravity. This machine, and a larger one, are used for making standards of length. When the standard yard, which is a square bar of steel, is placed in the larger machine, and the gravity piece adjusted so as just to fall by its weight, the heat imparted from the slightest touch of the finger instantly prevents its fall; thus showing the lengthening of the bar by so small an amount of heat as I have indicated. We have therefore in this mode of measurement all the accuracy we can desire; and we find in practice in the workshop, that it is easier to work to the ten-thousandth of an inch from standards of end measure, than to the one-hundredth of an inch from the lines on a two-foot rule. In all cases of fitting, end measures of length should be used, instead of lines.

This question of correct measurement is in immediate connexion with another, which will repay all the attention that can be given to it, and I think there is no subject that can be more profitably discussed amongst us;—I mean that of proper gradation of size in all the various branches of the mechanical arts. I think no estimate can be formed of our national

loss from the over-multiplication of sizes. Take, for instance, the various sizes of steam engine—stationary, marine, and locomotive. In the case of marine engines, the number of sizes up to 100-horse power will probably not be short of thirty, where ten perhaps would be ample. If so, look at the sums expended in patterns, designs, and in the number of tools for their manufacture. Nor is this all; for if there were only ten sizes instead of thirty, there would be three times the number made of each pattern; and, as you know, the very soul of manufacture is repetition. By attention to this, the ship-owner would be benefited by getting a better engine at a less price. In the case of locomotives and carriages, I would urge the subject on the attention of our members, the engineers of the great lines of railway—the London and North Western, the Midland, the Great Northern—for instance. I hope they will permit me to suggest that they should consider and determine not only the fewest possible number of sizes of engines and carriages that will suffice, but also how every single piece may have strictly defined dimensions. This question is also well worthy the attention of our architects and builders. Suppose, for instance, that the principal windows and doors of our houses were made of only three or four different sizes. Then we should have a manufactory start up for making doors, without reference to any particular house or builder. They would be kept in stock, and made with the best machinery and contrivances for that particular branch; consequently, we should have better doors and windows at the least possible cost. Our friends across the Atlantic manage matters in connexion with their buildings much better than at present we do.

I hope the members of this Institution will join me in doing what we can with reference to those two important subjects—correct measurement, and its corollary, proper gradations of size. The want of more correct measurement seems to pervade everything. Take, for instance, the case of the common brick, which ought to be three inches thick. Who is there that has made an addition to a building who has not felt inconvenience from the irregularity of size?—the new brick being perhaps too thick, and so not allowing sufficient mortar to be used; or too thin, and requiring too much mortar.

Perhaps one of the most effectual means that could be adopted, in the first instance, to remedy this unsatisfactory state of things, would be for the government to supply corporate bodies with proper standards of length—such as the inch, the foot, and the yard. The corporate bodies themselves might then have their own standards of size, founded on these, and made to suit the particular wants of the different trades in the locality. The only standard of length at present supplied by the Government, and kept by the corporate bodies, is the standard yard, but there is so little attention paid to accuracy, that to the engineer and machinist it is not of the slightest use, and is only employed to adjust yard sticks for measuring woven goods.

There is also another subject which bears upon this question, and which has lately been brought before the Legislature—that of decimalizing weights and measures. There can be no doubt of the beneficial results that would follow the passing of such a measure. There may be a difference of opinion as to what the unit or integer of lineal measure

should be; but I am of opinion that it should be the inch, for, from the accuracy with which we can now measure that length, there would be no difficulty in determining and fixing the length of its multiples. The most important divisions of length in mechanism are those of parts of an inch, and if the length of the inch were altered it would cause much confusion. Small accurate standards of length, of the decimal parts of an inch, would be of much service to some trades. There is now no standard of appeal; and the different wire and other gauges differ so considerably, that the manufacturer, in the case of small wire and sheets of metal, has to send a sample of what he wants, there being no means of correctly expressing its size.

Although I have said so much to you with reference to the desirableness of further improvement and greater perfection in the mechanical arts, I congratulate you on the success which in our time they have attained, and the high consideration in which they are held. Inventors are not now persecuted, as formerly, by those who fancied that their inventions and discoveries were prejudicial to the general interest, and calculated to deprive labor of its fair reward. Some of us are old enough to remember the hostility manifested to the working of the power loom, the self-acting mule, the machinery for shearing woolen cloth, the threshing machine, and many others. Now, the introduction of the reaping and mowing machines and other improved agricultural machinery is not opposed. Indeed, it must be obvious to reflecting minds that the increased luxuries and comforts which all more or less enjoy, are derived from the numerous recent mechanical appliances and the production of our manufactories. That of our cotton has increased during the last few years in a wonderful degree. In 1824, a gentleman with whom I am acquainted sold on one occasion one hundred thousand pieces of 74-reed printing cloth at 30*s.* 6*d.* per piece of 29 yards long; the same description of cloth he sold last week at 3*s.* 9*d.* One of the most striking instances I know of the vast superiority of machinery over simple instruments used by the hand is in the manufacture of lace, where one man with a machine does the work of 8000 lace-makers on the cushion. In spinning fine numbers of yarn, a workman on a self-acting mule will do the work of 3000 hand-spinners with the distaff and spindle; and there are other striking facts of a similar kind mentioned in my report on the New York Industrial Exhibition.

Comparatively few persons, perhaps, are aware of the increase of production during our lifetime. Thirty years ago, the cost of labor for trueing a surface of cast iron, by chipping and filing with the hand, was 12*s.* per square foot: the same work is now done by the planing machine at a cost for labor of less than 1*d.* per square foot, and this, as you know, is one of the most important operations in mechanics. It is therefore well adapted to illustrate what our progress has been. At the same time that this increased production is taking place, the fixed capital of the country is, as a necessary consequence, augmented; for, in the case I have mentioned of chipping and filing by the hand, when the cost of labor was 12*s.* per foot, the capital required for tools for one workman was only a few shillings; but now the labor being lowered to 1*d.* per foot, a capital in planing machines for the workmen is required, which often amounts

to £500, and in some cases more. This large outlay of capital invested in machinery to increase production, makes it impossible to curtail the hours of working machinery as much as could be desired. In some cases two sets of workpeople have been employed in relays, each working eight hours a day; and this system, perhaps, may in time be extended, although it is attended with certain inconveniences. If, however, the relay system could be so improved and organized as to allow more time for the better education of young operatives, none would more cordially rejoice than myself. I believe that mechanics, though a mere material power in itself, may, if rightly used, become a moral lever, by which, like Archimedes of old, we may seek to raise the world.

There is at the present time a very gratifying circumstance in connexion with the extension of machinery; namely, the large remuneration which the operatives receive compared with those who perform hand labor without the help of machinery. I would here mention, with reference to the amount of wages paid to the operative, that it does not depend solely on the master manufacturers of this country, but is governed in some measure by what is paid by the manufacturers of other countries who are in competition with our own. When in America in 1853, I found that the American operatives received somewhat more wages than are paid in this country; but they worked much longer hours, although the climate, during some parts of the year, is so unfavorable. These longer hours enable the American manufacturer to turn over his capital more frequently.

This question of increased production, with which we, as mechanical engineers, are so identified, is so entirely dependent on the power of the people to consume, that I hope I shall be excused in adverting to it. Our yearly exports now amount to about a hundred millions sterling, having doubled in a short time, while our home productions have been greatly increased from the same cause, namely, the increased ability of our people to consume. As a general principle, it would seem to be far better to levy a small impost on the entire wealth of an individual than to fasten a tax on particular objects, which, if produced, would constitute wealth, but which are not made because of the threatened impost. The remaining duty on carriages seems to me to be one of this description. Were there no tax, almost every one who keeps one carriage would keep more, while large numbers would have one who now have none. By their use, locomotion would be increased threefold, and hence much valuable time would be saved. Besides, what a number of the best description of artisans would be called into existence for their manufacture—a class, too, who are well able to turn their hand, in cases of necessity, to other employment. If, therefore, it is desirable for a nation to possess wealth in carriages, it is a mistake in legislation to prevent it.

Formerly, when the wealth of a nation was produced as it were by hand labor, a different state of things existed to that of the present day. As I have shown, our means of production are now increased in some cases more than a hundred, and in others more than a thou-

sand fold; and this will go on just in proportion as the masses of our people are able to consume larger quantities of everything that they require. When the farm laborer pays less for his sugar and tea, more meat will be consumed (which again goes to improve the land); also more wool for our manufacturers.

In this wonderful power of producing wealth which now exists, none can be more interested and benefited than the proprietors of the land. A striking proof of this is given by its increased value in the manufacturing counties, and for miles adjoining our manufacturing towns. The competition too of our manufacturers and merchants to become possessors of land, is shown by the small rate of interest with which they are satisfied for the outlay of their capital on the soil. The proprietors of land may rest assured that, in the future development of mechanical improvements, none will be more benefited than themselves. I do not hesitate to say that all harvest operations on land properly laid down, will very shortly be performed in one-fourth the time required with the hand labor now expended, by the farther application of machines worked by horse power. This is my conviction, based upon the experience I have had in the successful working of the machine I constructed for sweeping the streets, and at the same time filling the cart, by horse power. By the combined aid of mechanical improvements and the science of chemistry, together with the greater skill of our modern agriculturists, the culture of the land throughout Great Britain must more and more approximate to that of a garden.

We have seen the effect of the repeal of the duties on glass and bricks, in the improved appearance and reduced cost of residences, and a still further benefit may be expected to result from the removal of the remaining duty on timber. While therefore we congratulate ourselves on the great results which the mechanical arts have achieved, we have every reason to be thankful that our legislators have removed so many impediments to our progress. The glorious fruits of the legislative labors of that great and good man, Sir R. Peel, may give us hope that the time is not far distant when all remaining obstacles of this kind will be swept away. When that period has arrived, and when the industry of this country has been systematized upon sound principles of economical science, and in each department carried nearer to those standards which, in the case of mechanics, I have endeavored to indicate, we shall have less reason than at present to doubt the stability of our manufacturing pre-eminence.

Rendering Stuffs Water-proof.

The following is the method patented by M. Menotti for rendering stuffs water-proof, and yet allowing them to remain permeable to air. We translate the French measures assuming the litre as a quart, and the kilogramme as two and a quarter pounds avoirdupois.

Take two vessels of a capacity of five gallons each; place in one 22 lbs. of commercial sulphate of alumina chopped up fine; in the other, 9 lbs. oleic acid and 1½ gallons, alcohol ⅔. Stir this mixture well, and pour it

into the first vessel, taking care to stir well with a wooden ladle during the mixture, and for ten minutes afterwards. Let the mixture stand for 24 hours, then decant the oleic acid and alcohol which are floating on top. Throw the precipitate upon a felt filter, and press until all the liquid is run out. Take the precipitate from the filter and dry at 86°; when dried, powder it by rolling it upon a table with a wooden roller. This compound the author calls *hydrofugine*. To use this, dissolve it in 150 times its weight of warm water for woolen stuffs, while for linen, cotton, or silk, 100 times the weight will be enough. Filter the solution through linen, and plunge the stuffs to be water-proofed into it; soak them well, then take them out and wring them; soak them a second time, then take them out and dry them either in the air or before a fire. The stuffs will be found, when well dried, impermeable to water, but not to air. The quantity of hydrofugine necessary cannot be accurately determined, but generally 1 oz. is enough for two yards of cloth or four of muslin.

M. Thieux, of Marseilles, proposes a simpler process. In two vessels, each of a content of 12 gallons of river water are dissolved, in the one $3\frac{1}{3}$ lbs. of alum, in the other the same weight of sugar of lead. When the solutions are complete, pour the liquids together, by which will be formed an insoluble sulphate of lead, and soluble acetates of alumina and potassa, mixed with a slight excess of alum. As soon as the liquid has become clear, it is drawn off and the stuffs plunged into it; they must be strongly compressed while under the liquid to expel the air from their pores, and then suffered to soak for at least four hours, so as to insure the perfect penetration of the liquid everywhere. When withdrawn they are lightly shaken, then dried, brushed, and pressed with a hot iron. It appears that various specimens of cloth experimented on by the Committee, absorbed from 11 to 17 per cent. of their weight of saline matters, and retained their original appearance, and their pliability at all temperatures. But after immersion in fresh water for 24 hours, they lost all their additional weight. As to the efficacy in this process, there appears to be a very serious difference of opinion, the conclusions of the committee appointed to examine it, as reported by M. Jacquelan, are that it is not new, nor as good as was announced; but it had been tried and approved for five years by the Lyons and Mediterranean Railroad Company; that the committee could not tell whether it was durable or not: its cost was about 20 cents for water-proofing a coat or pair of pantaloons. On the other hand, M. Balard, known to all, as one of the most distinguished and careful chemists of France, reports that the thinnest woolen cloths impregnated with it, are totally impermeable to water after weeks of contact with it, that the water evaporates from them and does not pass through; that cloths which had been soaked for 48 hours in fresh water, were as impermeable afterwards as before; that clothes rendered waterproof in this way, and exposed on wicker-frames to the rains of October, never allowed a drop of water to pass; that a cloak of cloth thus prepared, stretched over a willow frame, and exposed to the stream from a fire engine worked by six strong men, from a distance of 15 yards, allowed no water to pass, except where the stuff was in contact with the frame and was compressed upon it by the violence of the jet, but the transpi-

ration from the skin appears to destroy the impermeability, so that it is probably applicable only to exterior clothing; finally, that there is every probability that it is lasting, as appears from the certificates. M. Balard himself testifies that an overcoat worn by him for five months, which had been beaten and rubbed and subjected to all the ordinary usage of overcoats, remained perfectly impermeable. Clothes prepared in this way are said to be softer to the touch, warmer, absorbing less moisture, drying more quickly, and therefore more durable.

It would appear, therefore, that this process, which is cheap and easily applicable, even after articles are made up, is well worth experimenting upon. *Bull. Soc. Encour., Sept. and Dec.*, 1855.

Electric Gilding, Silvering, and Platinating.

M. Landois, of Paris, announced to the Society for the Encouragement of National Industry, at their session of 25th December, 1855, that he had obtained a gold, silver and platina bath, having no deleterious exhalation and capable of depositing solid coating upon the metals. M. L. dissolves a given weight of cyanide of gold, silver or platina, in a saturated solution of common salt; the solution is filtered and may be then used. The galvanic deposit takes place cold very rapidly, and the results are equal to those obtained by MM. Ruotz and Elkington.

On various Phenomena of Refraction through Semi-lenses or Prisms, producing anomalies in the Illusion of Stereoscopic Images. By A. Claudet, Esq., F.R.S.*

The author having observed that photographic pictures representing flat surfaces, when examined in the refracting stereoscope, have the appearance of concavity, has endeavored to discover the cause of that phenomenon, and to explain it.

In order to ascertain if this peculiar effect was attributable to some imperfection in the lenses of the camera obscura which had produced the photographic pictures, or to a property of the stereoscope itself, he began to test the stereoscope without photographic images. For this experiment he placed under each tube of the stereoscope a diagram composed of vertical and horizontal lines crossing each other.

The two diagrams perfectly identical, when seen in the stereoscope coalesced and formed only one figure; but although each diagram, when seen separately by its corresponding eye, appeared perfectly flat, still the coalescing image of the two presented a surface conspicuously concave; consequently there was no doubt that the same illusion observed in photographic pictures was due only to the effect of the stereoscope. This experiment was decisive, and it remained to discover how the illusion was produced. The investigations showed that the phenomenon, which is a defect detrimental to the beauty and correctness of the stereoscopic representations, and unavoidable in the refracting stereoscope, is a plain illustration of the cause of relief and distance, and yield

* From the Lond. Repertory of Patent Inventions, Feb., 1857.

the clearest explanation of the stereoscopic illusion,—proving that it is founded on the true principles of natural binocular vision.

When we look through a prism placed near the eye at a straight line, the refracting edge of the prism being parallel with the straight line, that line is refracted laterally and appears bent, with its concave side turned to the thin edge of the prism. The two tubes of the stereoscope being supplied with semi-lenses acting as prisms, each lens bends all vertical straight lines, and the concave sides of these lines are turned towards the thin edges of the lenses, and consequently towards each other. When we examine in the stereoscope two curved lines having their concave sides turned towards each other, the result of the coalescing of these two lines is a concave line, the extremities appearing nearer and the centre further. If the convex sides are turned towards each other, the result of the coalescence is a convex line, the extremities appearing further and the centre nearer. By the same reason, if straight lines are bent by the prismatic refraction of the two semi-lenses, as the bending is effected so that the concave sides are turned towards each other, the result is by coalescence a concave line. The two photographic images will have all their vertical lines bent in the same manner, and the stereoscope will give the illusion of a picture represented on a concave surface.

When we look at natural objects, the optical axes have to converge more for the nearest than for the furthest, in order to obtain a single vision by bringing the same object on the centre of each retina; therefore by habit we judge of the distances by the angle formed by the optical axes required to obtain a single vision. Again, while we look at one object, while other objects in the same line are situated before and behind that object, we have the sensation of their double images on the two retina. The double images of nearer objects are situated in the following order: one on the right of the centre of the right retina, and the other on the left of the centre of the left retina; and the double images of further objects, one on the left of the right retina, and the other on the right of the left retina.

In looking at the two pictures in the stereoscopes, we have to converge the optical axes on one point which is beyond the plane of the pictures, so that two of their correspondent or similar points appear respectively on the two lines forming the angle of convergence of the optical axes, and each of these points is represented on the centre of one retina. As the two corresponding points of the two pictures are laterally nearer each other for the first plane and more distant for the receding plane, it follows that the optical axes have to converge beyond the plane of the pictures on a nearer point for the first, and on a further point for the last. Therefore, the angle of convergence by which similar points of the two pictures appear on each axis, and consequently fall on the centre of each retina, conveys the sensation of their respective distances; more convergence indicates less distance, and less convergence more distance. All the other corresponding points of the two pictures which are not on the optical axis, or on similar points of the two retina, form double images; and when we look at one point, all the points of nearer and further planes appear double in the same order on the two retina, as when we look in like manner at natural objects: and the situation of double

images seen through the stereoscope indicates the distances of the objects they represent, according as one is on the right of the right retina, and the other on the left of the left retina, or one on the left of the right retina, and the other on the right of the left retina.

This being explained, it is easy to understand what will be the stereoscopic result of vertical lines represented as curved, and having their concavities turned toward each other. The two correspondent points of the top and bottom of the two concave lines being nearer each other, will require more convergence than the two correspondent points of the centres of the concave lines, and will appear nearer, whilst the two points of the centre requiring less convergence will appear further; the intermediate points from the centres to the extremities of the two bent lines will appear gradually less distant, therefore the coalescence of the two lines bent laterally will produce the illusion of a single line conspicuously concave, in a vertical plane at right angles with the plane of the two separate lines.

Having demonstrated that the semi-lenses of the stereoscope, like prisms, bend laterally all the vertical lines of which the photograph pictures are composed, and that these lines in the two pictures present their concavity to each other, it is evident that the coalescence of the two images must give the illusion of a concave image.

The phenomenon of the lateral curvature given to vertical lines by the refraction of a prism, which vertical lines, when examined with two prisms, one for each eye, appear by coalescence as one line concave in a vertical plane at right angles with the plane of the two separate bent lines, can be curiously illustrated by the following experiment:—

If, holding in each hand one prism, the two prisms having their thin edges towards each other, we look at the window from the opposite end of the room, we see first two windows with their vertical lines bent in contrary directions; but by inclining gradually the optical axis, we can converge them until the two images coalesce, and we see only one window; as soon as they coincide, the lateral curvature of the vertical lines ceases, and they are bent projectively from back to front: we have then the illusion of a window concave towards the room, such as it would appear reflected by a concave mirror.

There is another phenomenon which can be noticed when looking at photographic pictures in the stereoscope; sometimes the pictures appear to project out, and sometimes to recede from the mountings. The first effect lessens the illusion, and the second renders it more effectual; therefore it is desirable to inquire how we can avoid the one and ensure the other.

We know that the distance of objects is in an inverse ratio with the angle of convergence required to see them single; also that with symmetrical figures or photographic pictures, when the horizontal or lateral distances of the several corresponding points is different, the points less separated will appear nearer, and the more separated will appear further.

Suppose the two correspondent vertical lines of the openings or frames of the pictures be more distant than the two correspondent points of the furthest plane of the picture themselves, then the openings or frames will appear behind the pictures; and suppose the correspondent vertical

lines of the openings be less distant than the two correspondent points of the nearest plane of the pictures themselves, then the openings or frames will appear before the picture.

Therefore, when we wish to have the picture appearing behind the openings or their mountings, we have only to take care that the correspondent vertical lines of the mountings should be laterally less distant than the two correspondent points of the first plane of the picture. This can be easily done by taking the measure of the two correspondent points of the first plane by means of a pair of compasses, and tracing the two pairs of correspondent vertical lines bounding the openings, after having slightly reduced the angle of the compasses.

A very simple experiment may show the cause of the illusion of concavity of flat surfaces when examined through semi-lenses, and further prove that semi-lenses may give alternately the illusion of concavity and convexity according to the position of their thin edges; of concavity when their edges are towards each other, and of convexity when they are placed contrarywise. For this experiment we have only to employ a pair of those spectacles mounted with a spring whereby they are held on the nose.

When we read, holding such spectacles with both hands, we may by the elasticity of the spring adjust the two lenses so that the pupils of the eyes can coincide, first, with the two nearest edges; secondly, with the two centres; and, thirdly, with the two furthest edges of the lenses.

In the first case, the page of the book will appear concave, because the pupils will look through the thin edges of the lenses which bend the vertical lines with their concave sides turned towards each other; in the second, the page will appear flat, because the pupils will look through the centres of the lenses which show the vertical lines perfectly straight; and in the third case, the page of the book will appear convex, because the pupils will look through the thin edges of the lenses which bend the vertical lines with their convex sides turned towards each other.

These considerations have led the author to construct a stereoscope which presents flat surfaces perfectly flat. This new stereoscope has two entire lenses instead of two semi-lenses, and the eyes look through the centre of such lenses. The images not being laterally refracted, as in the semi-lenticular stereoscope, their coalescence requires a certain effort of divergence, or to squinting outwards, which a little practice will enable us to perform easily. Persons capable of using this kind of stereoscope will see a picture whose surface is perfectly flat with all the illusion of relief and distance.

All lenses being more or less subject to the defect of bending straight lines when refracted by all the various points of their surface but the centre, and in a greater degree as those points are nearer the edges, it results that when images are produced in the camera obscura by the various points of the whole aperture, they will be bent in various contrary directions, and a certain confusion must arise injurious to the delicacy and correctness of the whole compound image. This may be proved by the following experiments:—If we take the image of a window by a small aperture placed on the right edge of a lens, say of three inches aperture, and another image of the same window, by placing the

aperture on the left, taking care to shift the camera so that the two apertures will be exactly on the same line, we shall have two images of the same window apparently identical; but in placing these two images side by side in the central lens-stereoscope above described, first the image of the left side aperture on the right, and that of the right side aperture on the left, secondly the images *vice versa*, we shall see in the first case a concave window, and in the second a convex window. But in examining the two images in the semi-lenticular stereoscope, we shall see in one case a concave window, and in the other a perfectly flat window, because in the first case the stereoscope will have increased the bending of the vertical lines of the two images, and in the second the stereoscope will have corrected the bending.

This fact naturally suggests the possibility of correcting the defect of the refracting stereoscope; for if the images of the camera were taken by semi-lenses, the bend resulting from this mode of operating might be corrected by the bend of the stereoscope, care being taken to turn the thin edge of the semi-lenses of the two cameras in the direction which will produce a bending contrary to that of the semi-lenses of the stereoscope.

Having shown how the lateral proportional distances of any two correspondent points of the two stereoscopic pictures are the indices of their perspective distances, if we were, while looking in the stereoscope, to produce a change in those proportional lateral distances by sliding horizontally in a contrary direction, two pairs of superposed glass photographic pictures, the objects would appear to move, not in the horizontal lateral direction of that change which they naturally have, but in a straight line forward and backward, as if the object was approaching or receding.

But the most curious effect of that motion would be, that the objects would appear increasing in size while they were receding, and diminishing while approaching, which we know is contrary to the rule of perspective. This is another illusion entirely physiological, and the cause of which may be thus explained; while the object appears moving forward and backward it remains always the same size, but as we expect when it moves forward that it should increase in size, and when it moves backward that it should decrease, and as it does not, we feel that it is diminishing when approaching and increasing when receding. —*Philosophical Magazine.*

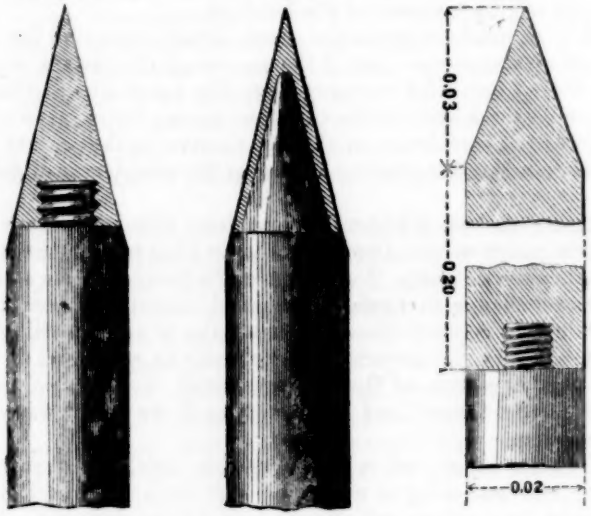
Lightning-Rod Points.

As the perfection of the lightning-rod ought to interest our readers in this country in an especial degree, we copy from the *Bulletin of the Society for the Encouragement of National Industry, of France*, the accompanying drawings of lightning-rod points. They are too simple to need much description. They are sections, 1st, of the point recommended by the Academy of Science, on the report of Messrs. Pouillet, Becquerel, Babinet, Duhamel, Despretz, Cagniard de Latour, Regnault, and de Senarmont; it consists of a solid cone of platina screwed

upon the iron rod; fig. 2d, of the improvement submitted by M. Deleuil, and approved by the Committee; it consists of a hollow platina shell of conical form soldered on the conical extremity of the rod.

The Committee add that they see no objections to making the point of palladium, gold or silver of 950 fineness, either solid or in sufficiently thick shell, provided care be taken that the soldering shall be effective on the whole surface. They also recommend on account of its cheapness, fig. 3d, a cylinder of copper 0·8 inches in diameter, brazed upon the end of the iron rod, and terminating in a cone 1¼ to 1½ inches in height; and they say that the danger of oxidation of such a cone, is

Fig. 1. Fig. 2. Fig. 3.



more than compensated by the advantages, which are, first, the high conducting power of copper; and, secondly, its cheapness. In regard to this, we would remark, first, that the conducting power of the point will be limited by that of the rod, and that any metal which will conduct as well as iron will answer in this respect equally well for the point. Secondly, that if we admit the liability of a good rod to be struck, as the Committee do, then the great fusibility of copper renders such a point dangerous. Thirdly, the platina work in Europe seems, from recent developments, to be still done by welding platina sponge, and we are not aware of any experiments to determine the electro-conducting power of platina which has been perfectly fused. We all know that the crucibles made from platina sponge are in laminæ, between which there is no true metallic contact. Fourthly, it seems worth while to inquire into the feasibility of using iridium, which is so largely contained in the gold from California; which is less fusible than platina, yet may be melted in masses large enough to make lightning-rod points.

Experiments on Wrought Iron Beams. By Thomas Davies, F.A.I.S.*

Read at a Meeting of the Architectural Institute, held in Edinburgh on Feb. 18, 1856.

The material first used in the construction of beams was doubtless timber, and although it has many properties peculiarly fitting it for this purpose, yet, on account of its flexibility, and the difficulty of getting it of sufficient size and strength for long spans, its tendency to decay, and its destructibility by fire, it is in many cases unsuited for the purpose required.

When the manufacture of cast metal became more general, and the means were obtained of making large castings, the applicability of this material to the formation of beams could not fail to suggest itself. This material has decided advantages—in its rigidity, in its capability of being made of almost any required shape and strength, in its non-liability to decay, and in its incombustibility; and consequently, it has come to be very extensively used for the purpose referred to.

There has, however, been a general want of confidence in beams of this material, arising from different causes. One objection is, that when a beam gives way, it does so without any previous warning. Another objection is, that although we have innumerable experiments on the strength of cast metal, by which we are enabled to calculate the amount which any particular beam of this material ought to carry, it does not follow that it will bear that amount. In a large casting there may be some inequality in the metal used; again, if there is much difference in the thickness of the parts, the cooling of one part before another produces, to some extent, a tendency to fracture, especially if subjected to any sharp concussion; or the casting may be clean and apparently sound, and yet there may be a flaw, of which nothing can be known until it is revealed by a fracture. No doubt, to guard against these defects, we have the system of testing; but this is not always to be depended upon, as it has been considered, that in some cases beams have been tested so nearly to the limits of their strength, that, though passing the ordeal, they have been permanently injured thereby. This suggests another objection, that though a beam be in every way sound, yet, if it is occasionally subjected to great strains, it will ultimately be so much weakened, as to break with a load much less than the original breaking weight.

The result of the want of confidence abovementioned has been, tha cast metal beams are generally made much stronger than, judging from experiment, they require to be, necessitating heavy castings and increase of cost, with the additional drawback of great weight and difficulty of handling.

Malleable iron beams unite, to some extent, the advantages of both timber and cast metal. They possess the advantage of timber, inasmuch as they are comparatively light, and therefore easily handled, and when overloaded, they show this by yielding considerably before breaking. They possess the advantage of cast metal in their incombustibility, in their being capable of being conveniently made of any required strength, and even to some considerable extent, in their rigidity; for although malleable iron is comparatively flexible, yet this quality is in a great measure counteracted by the mode of constructing the beams.

* From the Lond. Civ. Eng. and Arch's. Jour., January, 1857.

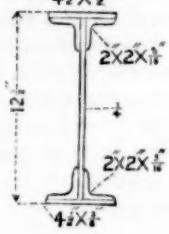
Messrs. Stephenson and Fairbairn, in their investigations and experiments relative to tubular bridges, were the first to call general attention to the use of malleable iron in the construction of beams. After many experiments on various sections of tubes, they arrived at the rectangular tube, or box beam, as the best; and it was a simple step, by dividing it in two by a vertical line, to come to the double flanch or plate beam, which is the most convenient shape for general use.

Mr. Fairbairn, in his valuable book on cast and wrought iron, shows the superiority, in many respects, of malleable over cast iron for beams. He shows, moreover, that, contrary to what takes place in cast metal, the upper flanch requires to be larger than the under one, in the proportion of 2 : 1, and gives formulæ for calculating the strength of beams. There is, however, this drawback, that while his book contains the details of many experiments on various sections of cast metal and malleable iron box beams, there is almost a complete want of experiments on malleable iron plate beams. There is given, in fact, the result of only one experiment on one kind of plate beam, and this experiment was not altogether satisfactory.

This circumstance, there is little doubt, has tended to deter many from adopting this kind of beam. Having made several experiments on the kind of beam referred to, I considered, under the circumstances, that the results of some of these might be acceptable in this Institute, and might tend to the more general use of a beam which has decided advantages for many purposes.

Having had my attention drawn to the applicability of malleable iron for beams, and having long shared in the general want of confidence in cast metal already alluded to, I determined to take the first opportunity of making a trial of them. An opportunity having afforded itself of using them, I consulted Mr. Tod, engineer, Leith Walk, and had the benefit of his experience; and I was so satisfied with the result of the trial, that since then I have not used cast metal for beams of any importance.

The beams in my first experiments, I am sorry to say, were tested by a Bramah Press which I afterwards discovered to be very inaccurate. The results of the experiments, however, which are to be laid before this meeting, are only those which have been obtained by the application of *dead weight*, so that there may be nothing to create want of confidence in the statements now laid before you. These experiments were made at various times in Mr. Tod's yard. None of the beams were tested till they broke, as all were intended for use; but, as most of them were tested to a deflection greater than that to which it would be advisable to have them permanently loaded, they give data for guidance in fixing the dimensions of other beams.



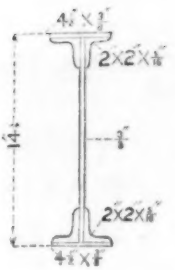
Experiment I.

Length of Beam,	.	12 ft. 0 in.
" Bearing,	.	11 " 8 "
Weight of Beam,	.	4 cwt. 1 qr.

The Load rested on 20 inches in the middle of the Beam.

Divisions of Load.			Load.			Deflection Loading.		Deflection Unloading.	
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	16ths.	Ins.	16ths.
0	0	0	0	0	0	0	0	0	0
33	0	21	33	0	21	0	2	0	3
42	2	14	75	3	7	0	3	0	4
65	2	14	141	1	21	0	4	0	5 nearly.
38	3	0	180	0	21	0	5		
27	0	7	207	1	0	0	6	0	6 full.
28	3	20	236	0	20	0	7	0	7

Load, . . $11\frac{3}{4}$ tons.
Deflection, . . $\frac{7}{16}$ths inch.
There being no apparent permanent deflection.



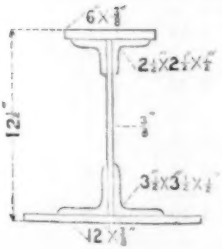
Experiment II.

Length of Beam, . 17 ft. 2 ins.
" Bearing, 16 ft. 6 "
Weight of Beam, . . 6 cwt. 2 qrs.

The Load rested on 21 inches in the middle of the Beam.

Divisions of Load.			Load.			Deflection Loading.		Deflection. Unloading.	
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	8ths.	Ins.	8ths.
0	0	0	0	0	0	0	0	0	1
37	2	0	37	2	0	0	1	0	2
33	0	24	70	2	24	0	2	0	3 nearly.
54	2	16	125	1	12	0	3	0	3 full.
52	0	0	177	1	12	0	4	0	4 full.
52	0	0	229	1	12	0	5	0	5

Load, . . $11\frac{1}{2}$ tons.
Deflection, . $\frac{5}{8}$ths inch.
Permanent deflection, . $\frac{1}{8}$th inch.



Experiment III.

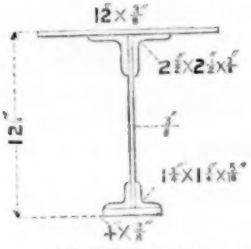
Length of Beam, . 30 ft. 0 ins.
" Bearing, 28 ft. 6 ins.
Weight of Beam, . 20cwt.2qrs

The Load rested on 27 inches in the middle of the Beam.

Divisions of Load.			Load.			Deflection Loading.		Deflection Unloading.	
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins.	8ths.	Ins.	8ths.
0	0	0	0	0	0	0	0	0	3
34	1	4	34	1	4	0	2	0	5
12	3	12	47	0	16	0	3	0	6
9	2	16	56	3	4	0	4	0	7 nearly.
13	3	20	70	2	24	0	5	1	0 nearly.
12	3	12	83	2	8	0	6	1	0 full.
16	0	8	99	2	16	0	7	1	1 full.
13	0	0	112	2	16	1	0	1	2
13	0	0	125	2	16	1	1	1	3
13	0	0	138	2	16	1	2	1	4 nearly.
13	0	0	151	2	16	1	3	1	4 full.
13	0	0	164	2	16	1	4	1	5
13	0	0	177	2	16	1	5	1	6
13	0	0	190	2	16	1	6	1	7
13	0	0	203	2	16	1	7		
13	0	0	216	2	16	2	0	2	0

Load, $10\frac{3}{4}$ tons. Deflection, 2 inches. Permanent deflection, $\frac{3}{8}$-inch.

Experiment IV.



Length of Beam, . 29 ft. 6 ins.

" Bearing, . 28 " 6 "

Weight of Beam, . 14 cwt. 3 qrs.

The Load rested on 22 inches in the middle of the beam.

Loading.							Unloading.						
Divisions of Load.			Load.			Deflection.	Divisions of Load.			Load.			Deflection.
Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins. 8ths.*	Cwt.	Qrs.	lbs.	Cwt.	Qrs.	lbs.	Ins. 8ths.*
0	0	0	0	0	0	0 0	0	0	0	0	0	0	0 3½
.	.	.	.	.	.	. . .	5	3	8	5	3	8	0 4
17	1	24	17	1	24	0 1	8	2	26	14	2	6	0 5
11	2	16	29	0	12	0 2	11	2	16	26	0	22	0 6
11	2	16	40	3	0	0 3	11	2	16	37	3	10	0 7
11	2	16	52	1	16	0 4	11	2	16	49	1	26	1 0
8	2	26	61	0	14	0 5 nearly	11	2	16	61	0	14	1 1
11	2	16	72	3	2	0 6	11	2	16	72	3	2	1 2
11	2	16	84	1	8	0 7 full.	11	2	16	84	1	18	1 3
8	2	26	93	0	16	1 0	11	2	16	96	0	6	1 4
8	2	26	101	3	14	1 1	11	2	16	107	2	22	1 5
11	2	16	113	2	2	1 2 full.							
8	2	26	122	1	0	1 3	11	2	16	119	1	10	1 6
8	2	26	130	3	26	1 4	11	2	16	130	3	26	1 7
8	3	22	139	3	20	1 5	15	0	22	146	0	20	2 0
9	1	14	149	1	6	1 6 full.							
6	1	0	155	2	6	1 7	12	2	0	158	2	20	2 1
6	1	0	161	3	6	2 0							
6	1	0	168	0	6	2 1 full.							
3	0	14	171	0	20	2 2	12	2	0	171	0	20	2 2

*The deflections were observed to 16ths of an inch, but the 8ths only are here given.

Load, . . $8\frac{1}{2}$ tons.
Deflection, . . $2\frac{1}{4}$ inches.
Permanent deflection, . $\frac{7}{16}$-inch.

Experiment V.

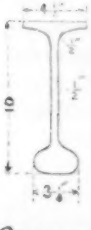
Length of Beam, . 23 ft. 6 ins.
" Bearing, 22 " 6 "
Weight of Beam, . 13 cwt. $2\frac{1}{2}$ qrs.

The Load rested on 21 inches in the middle of the Beam.

Loading.				Unloading.		
Divisions of Load.	Load.	Deflection.		Divisions of Load.	Load.	Deflection.
Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.		Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.
0 0 0	0 0 0	0 0		0 0 0	0 0 0	0 2
. . .	. . .	. . .		17 1 24	17 1 24	0 3
34 3 20	34 3 20	0 1		20 1 14	37 3 10	0 4
20 1 14	55 1 6	0 2		23 1 4	61 0 14	0 5
26 0 22	81 2 0	0 3		23 1 4	84 1 18	0 6
23 1 4	104 3 4	0 4		23 1 4	107 2 22	0 7
20 1 14	125 0 18	0 5	)	23 1 4	130 3 26	0 8
18 1 8	143 1 26	0 6	(	25 0 0	155 3 26	0 9
18 3 0	162 0 26	0 7	)			
18 3 0	180 3 26	0 8		25 0 0	180 3 26	0 10
18 3 0	199 2 26	0 9	)	25 0 0	205 3 26	0 11
15 2 14	215 1 12	0 10	)			
15 2 14	230 3 26	0 11		25 0 0	230 3 26	0 12
12 2 0	243 1 26	0 12	)	21 3 14	252 3 12	0 13
12 2 0	255 3 26	0 13	)			
13 1 12	269 1 10	0 14		16 1 26	269 1 10	0 14

Load, . . $13\frac{1}{2}$ tons.
Deflection, . . $\frac{7}{8}$ths inch.
Permanent deflection, $\frac{1}{8}$th inch.

I have as yet had only one opportunity of testing a rolled malleable iron Beam, of which the following is the result:—



Experiment VI.

Length of Beam, . . 10 ft. 9 ins.
" Bearing, . 10 " 3 "
Weight of Beam, . . 3 cwt. 21 lbs.

The Load rested on 8 inches in the middle of the Beam.

On account of some circumstances the testing was not quite so satis-

factory as could have been desired, so that the observed intermediate deflections are not given. The total load, however, was (204½ cwt.=) 10¼ tons. The deflection was ⅜ths of an inch, or perhaps $\frac{7}{16}$ths of an inch. The permanent deflection, after the removal of the load, was ⅛th of an inch.

It ought to be noticed, that the loads by which the beams in the foregoing experiments were tested, consisted for the most part of railway bars, requiring two men at each end to lift them, and that in loading there was a considerable amount of concussion and vibration, so that the test was considerably more severe than that due to the mere application of the load stated.

The foregoing are the details of all the experiments I have to bring before the meeting. I do not attempt from so few cases to generalize; but in the meantime I leave them before the Institute for their consideration. I may mention, that I am inclined to doubt the accuracy of the proportions of the upper and under flanch for plate beams, as given by Mr. Fairbairn; but I am not at present in a position to speak definitely on this subject. (See Appendix.)

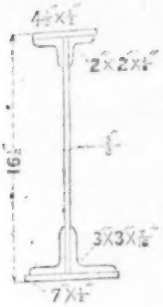
There is one remark, however, which I beg to make, before concluding this part of the paper. The flexibility of malleable iron beams, is no doubt greater than that of cast metal beams, but it is not so great as to prevent them being used for most purposes. For instance, it might be supposed that such beams were, from this cause, inapplicable to the support of walls already built, where the lower part has to be removed, as in the case of the alterations in shop fronts, which are continually being made in this city; but I may give the result of an experiment made in an alteration in Princes-street, as a case in point.

A pair of beams were used, similar to that referred to in Experiment II, except that they were 2 inches deeper, the length being 14 inches greater, and the actual bearing, when put in their place, being 16 ft. 8 ins. After the masonry above the beams had been keyed up, and the supports to the walls removed, so as to throw the whole weight of the wall above upon them, the deflection was only $\frac{1}{20}$th of an inch. I do not mean to say, that this was all the beams had yielded; but the keying up, before the supports were removed, had taken up whatever additional yielding there had been, although this must have been very little, as there was no appearance, so far as the eye could detect, of any deflection in the beams.

Appendix.

As already stated in the body of the paper, I was inclined to doubt the accuracy of the proportions of the upper and under flanches, as stated by Mr. Fairbairn. Since then I have made another experiment upon the beam used in Experiment V, but reversed; that is, with the large flanch, undermost, the results of which is given in the annexed table—

Experiment VII.



(Same Beam as tested in Experiment V. the larger flanch being undermost.)

Length of Beam, . 23 ft. 6 ins.
" Bearing, . 22 " 6 "
Weight of Beam, . 13 cwt. 2½ qrs.

The Load rested on 21 inches in the middle of the Beam.

Loading.			Unloading.		
Divisions of Load.	Load.	Deflection.	Divisions of Load.	Load.	Deflection.
Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.	Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.
0 0 0	0 0 0	0 0	0 0 0	0 0 0	0 3
24 2 1	24 2 1	0 1	19 0 7	19 0 7	0 4
17 1 3	41 3 4	0 2	19 2 21	38 3 0	0 5
18 0 24	60 0 0	0 3	21 1 0	60 0 0	0 6
18 0 24	78 0 24	0 4	27 1 8	87 1 8	0 7
14 3 16	93 0 12	0 5 bare			
17 1 12	110 1 24	0 6	34 2 24	122 0 4	0 8
20 1 0	130 2 24	0 7			
20 1 0	150 3 24	0 8	34 2 24	156 3 0	0 9
23 0 16	174 0 12	0 9	31 3 8	188 2 8	0 10
20 1 1	194 1 13	0 10			
27 1 18	211 3 3	0 11	23 0 23	211 3 3	0 11
15 0 20	226 3 23	0 12	15 0 20	226 3 23	0 12
15 0 20	242 0 15	0 13	15 0 20	242 0 15	0 13
15 3 6	257 3 21	0 14	15 3 6	257 3 21	0 14
12 0 16	270 0 9	0 15	12 0 16	270 0 9	0 15

Load, . . 13½ tons.
Deflection, . . $\frac{15}{16}$ths inch.
Permanent deflection, $\frac{3}{16}$ths inch.

The circumstance of this being the same beam which was tested in Experiment V. and which received a set of $\frac{1}{8}$th of an inch in the opposite direction from that in which it was strained in the present instance, accounts for the apparent anomalies in the above experiment, as compared with the results of the former. Thus, at the commencement of the second testing, the beam falls more quickly than on the former occasion, while as the experiment proceeds, it seems to recover strength, and there is little difference in the ultimate strength in both cases. Again, in unloading, the beam in the second testing springs up more quickly than in the first, which is inconsistent with the idea of its being weaker, as the observed deflections imply.

An allowance ought therefore to be made for the previous set of $\frac{1}{8}$th of an inch, and the following table is probably near what ought to be substituted for that just given.

Experiment VII.—(as corrected.)

Loading.			Unloading.		
Divisions of Load.	Load.	Deflection.	Divisions of Load.	Load.	Deflection.
Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.	Cwt. Qrs. lbs.	Cwt. Qrs. lbs.	Ins. 16ths.
0 0 0	0 0 0	0 0	0 0 0	0 0 0	0 1
. . .	. . .	. . .	19 0 7	19 0 7	0 2
35 0 0	35 0 0	0 1	19 2 21	38 3 0	0 3
23 0 0	58 0 0	0 2	21 1 0	60 0 0	0 4
27 0 0	85 0 0	0 3	27 1 8	87 1 8	0 5
25 1 24	110 1 24	0 4	34 2 24	122 0 4	0 6
20 1 0	130 2 24	0 5			
20 1 0	150 3 24	0 6	34 2 24	156 3 0	0 7
23 0 16	174 0 12	0 7	31 3 8	188 2 8	0 8
20 1 1	194 1 13	0 8			
17 1 18	211 3 3	0 9	23 0 23	211 3 3	0 9
15 0 20	226 3 23	0 10	15 0 20	226 3 23	0 10
15 0 20	242 0 15	0 11	15 0 20	242 0 15	0 11
15 3 6	257 3 21	0 12	15 3 6	257 3 21	0 12
12 0 16	270 0 9	0 13	12 0 16	270 0 9	0 13

Load, . . . 13½th tons.
Deflection, . . $1\frac{3}{16}$ths inch.
Permanent deflection, . . $\frac{1}{16}$th inch.

It would have been desirable, in order to have obtained the strength of the beam, as above, without requiring to have recourse to allowances, to have used a beam which had not been previously strained by testing. This was intended in making the above experiment; but through a mistake, the same beam was used over again, and there was not an opportunity of making another experiment before the beams were sent away.

It would be very unadvisable to attempt to draw particular conclusions as to the exact proportions of the upper and under flanches, from these two experiments merely, but the results seem to warrant us in coming to the general conclusion, that for this kind of beam the flanches ought to be nearly equal, the under flanch being rather larger than the upper.

Since making this last experiment and coming to the above general conclusion, and while preparing this paper for the press, I have seen a new work by Mr. Fairbairn, entitled, "Useful Information for Engineers." In it he inserts some of the mathematical investigations of Mr. Tate on the subject, which quite agree with the statements here made. Mr. Tate concludes his remarks by saying—"The difference in the value of these constants is so small, as to lead us to infer, that the beam in Experiment 12 approaches to that of maximum strength with a given quantity of material. The sectional area of the top and bottom flanches are to each other as 14 : 15, which is very nearly a ratio of equality.

For the Journal of the Franklin Institute.

On the proper mode of Constructing an Ice Boat. By A. C. Jones.

The experience of another winter being had in channel-breaking, and the city ice boat being, like most defective things which by long familiarity grow into favor with their age, and at last are believed to be *perfect;* I holding a contrary opinion, will review some of her doings, and also offer some other suggestions in connexion with my former communication on the same subject, and I do this because there has been no more improvement made during the twenty years experience had in channel-breaking, than could have been obtained in one winter's trial. This is proved by an examination on board, and her performance in the ice.

Living within walking distance of the famous "horse shoe," I am familiar with its peculiarities, and have been more than once an eye witness of forcing a passage through it, and, with all due deference to the opinions of others, I do not consider it so very formidable, or if I am mistaken, how is it that the ice boat got so soon through "ice packs, 6, 8, and 10 feet above, and 10 to 12 feet below the water surface"* with the thermometer nearly at zero, and yet, on the 10th of February, (20 days later,) made such poor time from Greenwich point to Kaighn's point, and thence to the Navy Yard, where there was none of these *eighteen to twenty feet thick masses of ice*, and what ice there was, had been softening from January 26th, by thaws every day, and on two days much rain fell. An article in the *Public Ledger*, eulogistic of the ice boat bears me out in what I incidently touched on before; on "January 9th a drag link broke—on the 12th a crank broke," (both requiring 4½ days to replace) "and much time was lost in prying the engines off their centres, once having to send to the city for jacks-screws for that purpose;" if *properly* constructed friction couplings had been in use, neither of these breakages would have occurred, and as the engines could with ease be coupled either at half stroke, or at any other point, while in motion, *without any shock*, all this labor and ado about getting the engines off their dead points, (*which is a common thing in ice breaking*,) would have been saved. Again, "the broken ice in the way of her next effort, was found to interfere so much with her progress, by breaking the force of her onset," that the boat was laid by until the *tide turned, so as to float it out of her way.*

Much might be written on auxiliaries to ice breaking, as stamping; blasting, butting, the battering ram, running up on the ice and breaking it down; they are *all* good under certain circumstances, and if at hand their use would be proper. I protest against one principle being carried out and considered perfect, when no other plan has been tried on the river even by experiment.

By an oversight I omitted to state in the paper published before on the

* If this boat passed so quickly through such formidable masses of ice, Mr. Grinnell made a great mistake in not securing her services for the recent exploring expedition, as by doing so, the solution of a "North-West Passage," would not have long remained in doubt.

"rooting" plan, that the stem of the boat *below* the point of the ridge, could be either vertical or at an angle, and of course the "butting" principle could be carried out when required in packed ice.

Power may be wastefully employed, and it carries with it increased expense.

I am satisfied of the correctness of the position, that sheet ice, (which is $\frac{4}{5}$ths of the work) *can be broken upwards by an inclined ridge or planes, with the least consumption of power;* and that the ice so broken *should be put out of the channel*, as it is well known that broken ice will become in a short time as compact as before, and herein lies one of the objections to relying on the butting principle as now practised, for the floating cakes not only clog the hull and wheels, but remaining floating in the channel freeze together, and the same work has to be done over again, and again.

Now, suppose we use below the point of ridge, a vertical stem, or have it at an angle, (the bow would then present lines all running to a point >,) and heavy packed ice is met; the boat has prepared a clear channel to *back in*, (the broken ice having been sent over the sheet ice out of the way,) and the boat is "butted" up against the mass crushing and breaking a portion of the ice, that above will be forced sideways; the boat is backed, and again runs up, and the loose fragments floating are forced up the inclines and are thrown off before the impetus of the boat is checked, and this, the severest duty of the boat, can be best performed with the tide.

If such a boat was in existence, I would not have the Philadelphia custom of allowing the river to be a month frozen before operations are begun, but as soon as the ice was of a sufficient thickness, then break from the Navy Yard down the river a single channel and *no more*, (except the ice was moving,) and keep plying to and fro in *that channel*, having depots of fuel at points on the river, not as at present, when the boat should be at work below Chester, to be compelled to come back to the city for fuel, and thus give "Jack Frost" time to add to the thickness and cement the broken mass.

With this plan put in operation then, the famous "horse shoe" would lose part of its troublesome character, which it obtains by the broken pieces of ice carried by the tides, which naturally packs in the "bights" of the river, and there freezes into compact masses. Of course towing should not be the duty of the boat, except to assist the "tugs" as a pioneer in difficult places. As a boat for ice breaking is required but for a fraction of the year, to make the same boat productive she must be used for towing, and of course, a bow proper for the former purpose would be objectionable for the latter. Suppose we should take a hull modelled for towing; a "plough or rooter," carrying out the principle I have explained, can be attached to the bow of this boat, (something like the "snow plough" to a locomotive engine,) or any other boat having sufficient power, and she becomes an efficient ice breaker for either "sheet" or "pack ice"—and in one day after her services are not required for such duty, the plough can be removed, and then the boat can be employed as a tow boat, &c. The plough to be attached again the next winter to break a channel.

I claim for the plans suggested as compared with the present ice boat,—

1st. Much less risk of breakages, and their consequent delays.

2d. Less power required to break sheet ice, and consequently economy.

3d. Keeping an open channel by removing the broken ice from it.

4th. Greater power and facilities for butting.

5th. An equal utility as a tow boat, when not required to break ice.

6th. And the power to *widen the channel* by cutting the ice on one side, sending the broken ice over the solid ice, out of the way of the open channel.

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*Astronomical Expedition to the Peak of Teneriffe.**

(Continued from page 189.)

Closely connected with radiation is the quantity of the light emitted by the heavenly bodies, and this was examined frequently in the case of the sun and moon and different parts of the sky by observations of Trauenhofer's lines in the spectrum. Stoke's spectrum was also examined, as recommended by the Royal Society, and was found to be traceable beyond the furthest point previously ascertained elsewhere. Means of photographing this spectrum, were also prepared, and some pictures of it, on glass, obtained, showing many of the dark lines beyond H, the usual limit of vision.

Several hundred measures of the polarization of the sky-light were likewise obtained, and the zodiacal light and twilight were frequently made the subject of numerical observation; continual registers of the barometer, dry and wet bulb thermometer, and the electrometer, being kept up during the whole of the time.

The geology of the peak could be well examined from this point, and offered much of exceeding interest, as did also the magnetism and botany of the neighborhood, while the remarkable moderation of the wind, considering that it was a mountain top, allowed researches to be carried on without let or hindrance throughout the twenty-four hours.

On the whole, therefore, Guajara approved itself admirably as a station for ascertaining the astronomical qualities of the atmosphere at the height of 8870 feet; but still, Professor Smyth could easily see that he had by no means reached the *ne plus ultra*, and might evidently effect even far greater improvement by rising yet higher above the atmospheric impurities that linger about the surface of the earth. "Raised we were," he says, "far above the level of the actual cloud of the N. E. wind, but we were not always above the wind itself; and even, as this rose and predominated over the station, so did telescopic definition become bad. We were also more frequently than otherwise, enveloped in a dusty, smoky sort of medium, whose vast strata piled one on the other, and stretching out to the distant horizon, rose some thousands of feet above our heads, and only the peak itself seemed high enough to be fairly above these upper mists. To the peak, therefore, it was evident we

* From the Lond. Mech. Mag., November, 1856.

must go to reap all the astronomical advantages which Teneriffe is capable of yielding.

The peak, however, was not so simple a matter to reach as the first station, for the top is not accessible on account of the constant evolution of sulphurous vapors, while a considerable portion of the slope below it, is impracticable on account of the broken lava-streams by which it is covered. The time also being short, while himself still observing at Guajara, the Professor sent men to explore the ascent, to ascertain the highest available station, and to build the walls of a scientific encampment, according to a plan furnished them. Then, on the 28th of August, the party moved over with all their instruments mounted on a train of twenty-seven horses and mules; and after a day's hard work, toiling through the pumicestone soil and rugged lavas of the old crater, and after a long steep climb, occupied before night their new position of the Alta Vista. "Perched on the top of a ridge of pumice and red lava on the southeast slope of the Peak, at an elevation of 10,900 feet, the Alta Vista forms," says Professor Smyth, "a comfortable little shelf, tolerably level, and is the highest point accessible to mules. On no other side can they ascend so high, by reason of the torrents of black lava blocks, which there cover the flanks of the mountain, but which have in this case curiously divided, and left a narrow and steep roadway of the older rock between two embankments of the newer scoria. These ridges, rising to the height of about thirty degrees, served admirably to protect us from the wind towards the S. W. and N., and, if they did interfere with the ruder eye observations of some phenomenon near the horizon, they contributed to the advantage of telescopic observations with high magnifying powers directed to the zenith. Here, therefore, was the place where the great Pattinson equatorial must be erected, if at all."

On the 25th of August, after the elevation of this instrument had been pronounced by his friends as hopeless, the indefatigable Professor, leaving the men to roof in the newly built walls, descended the mountain to see what could be done in carrying it up. This instrument, with an object glass of $7\frac{1}{4}$ inches aperture and 12 feet focus, and with an equatorial mounting entirely in metal, and of the first class of finish and perfection, in accordance with the requirements of modern astronomy, had been taken to pieces by its maker in England, as far as he had thought safe or practicable for its re-erection on a mountain side, far from the resources of workshops. But as he had not reduced it to its primitive elementary parts, the unwieldier masses could still be subdivided and packed up into smaller parcels. To this, therefore, Professor Smyth applied himself, and, assisted by an ingenious mechanic of the place, separated, and finally packed in 13 boxes what had been arranged by the maker in three. Then starting from the town at daylight on the 30th of August with 11 horses and men, the whole of the cases were taken up to the Alta Vista by sunset the same evening. On the second day, notwithstanding a storm of wind and sand which raged for the two days, the complete equatorial, with clock motion, axes well adjusted, and verniers reading off accurate places on finely divided circles, was in full operation, the first time that such a thing had ever taken place so high above the level of the sea.

But now only a fortnight of the prescribed time remained, and there were marked indications of the premature breaking up of the fine season. Professor Smyth set to work, therefore, without loss of time to determine, in the first place, the degree of definition in the atmosphere; for very grave fears had been thrown out that the hot vapors from the Peak would be utterly fatal to telescopic vision. The definition, however, proved admirable; so much so, that not only once, but every night for a week, he could see that difficult test B and C of γ Andromedæ as two distinct stars; nor could he find any object in the lists of the "Cycle" that were not separated by the telescope, and with ease.

Equally with regard to the range or visibility did the atmosphere approve itself; for the very faintest star to the practised eye and powerful telescope of the observer of the "Cycle" proved easy to even an inexperienced person in the Pattinson equatorial.

Directing them to planetary bodies, the fine division of Saturn's ring —a much contested matter—came out unmistakably, and revelations of clouds appeared on Jupiter's surface, which were eminently smaller in form, and as continually interesting in their changes as those of the sea of lower clouds brought about Teneriffe daily under their eyes by the N. E. trade winds. Of the moon, some extraordinary views were obtained, notwithstanding its unfortunately low altitude at that time, and the sun was observed both optically and photographically.

Daily, however, the weather, which had been in a manner disjointed by the storm on the 1st, was becoming worse; and the wind continually increasing, now began to shake the telescope so as to prevent the employment of high magnifying powers. Then the sky became cloudy; and at last, on the 14th of September, the storm broke in earnest, beginning with a rattling fall of hail.

"That night," says Professor Smyth, "above two inches of rain fell, and the climate altered so much that the natives would no longer remain with us. But the temperature was by no means unbearable to Northern men, and the sailors from Mr. Stephenson's yacht, proving good men and true, I still hoped to be able to see out the last of the clouds, and to finish several series of observations which had been interfered with by them. The break up of the summer weather had, however, been too complete, and though we stayed till the last possible day, we never saw the clear sky again; so, on the 19th, we dismantled the buildings, made a *caché* of such materials as might be useful in a future year, and went down to Orotava with the instruments and baggage."

During the Alta Vista period of these experimental labors, the smaller instruments before employed at Guajara were again in action; an improved method of observing the black lines in the spectrum was devised; some meteorological ascents and descents of the mountain were made, according to the suggestions of the Royal Society; and Humboldt's horizontal fluctuation of the stars, and the nature of the ice cavern, as recommended by Sir J. Herschel, were examined into. The crater of the Peak, the Montana Blanca, and various places remarkable for their geology or botany, were visited with hypsometric instruments, and with a photographic camera, by the aid of which about 200 pictures were obtained.

Finally, in concert with a Spanish gentleman of great local know-

ledge (Don Martin Rodriguez, of Cegas), the Professor examined the upper part of the mountain, and found a station that, with a little expense, might be made available for another year, and besides greater height, would possess some other advantages over either the Alta Vista or Guajara. Arrived in Orotava, he employed himself for a week settling the accounts, in examining the zeros of his meteorological instruments, and in photographing and measuring some remarkable volcanic features in the neighborhood, and also the great dragon tree, as recommended by Sir John Herschel. Then on the 26th of September he rode over to Santa Cruz, and having examined the tide gauge which, with the assistance of Mr. Hamilton and the warm co-operation of the Spanish engineers, he had had constructed on the mole, to meet the wishes of the Master of Trinity College, Cambridge, he embarked on board the yatch *Titania* the same evening. The captain immediately set sail, called off Orotava the next day, September 27th, for the instruments and baggage, and has now safely brought them back to England, after an absence of 117 days. Of these 36 have been spent at sea, 18 in the low lands of Teneriffe, 37 at the height of 8870 feet, and 26 at the height of 10,900 feet.

Translated for the Journal of the Franklin Institute.

Simple Electric Machine.

M. Thore united the ends of a strip of paper about 8 inches in width, so as to make a continuous band of it, and stretched it on two wooden pulleys covered with silk, one of which was rapidily turned around by a handle; the electricity was developed by pressing a warmed flat-iron upon the paper as it passed over one of the pulleys. He describes the effects as remarkable.

There is nothing new in the observation of the electricity developed by paper, and many of our machinists have noticed how often the bands of their machinery became electrically charged. But the apparatus is simple and cheap, and capable of working under atmospheric conditions which arrest the action of our ordinary machines.—*Academy of Sciences* (Paris), May, 1856.

Simultaneous and Opposite Electric Currents in the same Wire.

M. Petrina has investigated this disputed phenomenon by means of the reduction of temperature which Peltier discovered to take place when an electric current passes from bismuth to antimony. A metallic bar of these two metals soldered together in the middle, was introduced into the bulb of an air-thermometer, and divided currents from the same battery carefully equalized, were passed through it in opposite directions. In this case, if no current passes, no effect should be produced; but if both pass, since the cooling effects are known to be much less than the heat produced by the same current when passing in the opposite direction, the thermometer should indicate such heat. In fact, no effect was produced when the currents were equalized, and when they were allowed to be unequal, the heat was that due to the difference of the currents.—*Cosmos*, July, 1856.

Extraction of Sugar from the Juices of Vegetables.

M. Maumené (*Ann. de Chim. et de Phys.*, Sept., 1856), after recalling the well established fact, that a cold solution of sugar gradually changes from cane sugar to grape sugar, and showing that this is the case even when the juice remains in the vegetable, and that hence, a very notable proportion of sugar is lost in manufacture, proposes to remedy this evil by adding to the expressed juices rather more than half the weight of the contained sugar, of slacked lime in powder. His experiments on a small scale, and the application of his method by manufacturers of beet sugar, seem to establish the applicability of his process, which may be of great value to the owners of our sugar plantations.

For the Journal of the Franklin Institute.

Particulars of the Steamers Galveston and Opelousas.

Hull built by J. Simonson, New York. Machinery by the Allaire Works, New York. Owner, C. Vanderbilt, Esq. Intended service, Berwick Bay to Galveston, Texas.

HULL.—

Length on deck,	236 feet.	
" at load line,	230 "	
Breadth of beam (molded),	37 "	
Depth of hold to spar deck,	12 "	3 inches.
Draft of water,	6 "	6 "
Tonnage, hull and engine room,	1000.	
Area of immersed section at load draft,	210 sq. ft.	
Masts—two—schooner rigged.		

ENGINES—Vertical beam.

Diameter of cylinder,		44 inches.
Length of stroke,	12 feet.	
Cut off—at one-half.		

BOILER—One—Return flued.

Breadth of boiler at furnace,	14 feet.	
Diameter " "	10 "	6 inches.
Height " exclusive of steam chimney,	10 "	6 "
Number of furnaces,	three.	
Breadth "	4 "	2 "
Length of grate bars,	6 "	
Number of flues or tubes,	above, six—below, four.	
Internal diameter of flues or tubes,		16¾ "
Diameter of smoke pipe,	4 "	5 "
Height " "	40 "	

WATER WHEELS.—

Diameter over boards,	30 feet.	
Length of blades,	6 "	6 inches.
Depth "	2 "	
Number "	twenty-six.	

Remarks.—Date of trial, March, 1857. Frames, *molded*, 15 inches, *sided*, 12 inches; 24 inches apart from centres, and strapped with diagonal and double laid braces, $4 \times \frac{1}{2}$ inch. Depth of keel, $6\frac{1}{2}$. One independent steam, fire, and bilge pump. Boiler, chimney and smoke pipe protected from communicating fire by felt and sheet iron. Has a light deck over main deck, which is enclosed at sides. C. H. H.

*On a Mode of Giving a Metallic Surface to Horn.** By M. MEUNIER.

The articles made of horn are first prepared as usual, and then coated with chloride of zinc, either by immersion or with a brush. A yellow bronze color is produced; chloride of copper gives a blackish-bronze, chromate of copper a brown-bronze, and chromate of zinc a green color. Iodide of potassium, applied over any of the copper colors, renders them red. The objects soaked with the solutions of these salts are exposed to a temperature of 154° F., and rubbed after drying, with a mass composed of 5 parts of mercury, 15 parts of tin, 3 parts of sulphur, and 5 parts of muriate of ammonia, in the preparation of which the mercury and tin are first combined into an amalgam, which is then powdered and mixed with the other substances. The objects are then heated in a flask in the sand-bath until the mercury is evaporated, and a yellow mosaic gold is obtained.—*Polyt. Centralblatt*, 1856, p. 574.

Accident to the Dover Submarine Cables.†

An accident happened to the submarine line across the Channel, and telegraphic communication with the continent was temporarily delayed in consequence. During the fearful gales on the 5th inst., a ship of 700 tons, heavily laden, lost her anchor in the Downs, and, driven by the force of the gale and tide, fouled a schooner; she then, becoming more unmanageable, drifted into five fathoms water. An anchor was speedily let go, with 40 fathoms chain attached; but the barque, still impelled by the unusual force of the gale, dragged her anchor until she was brought up sharply, head to wind, on opening the western light of the South Foreland. It is feared that she here came upon the Submarine Company's Ostend Cable. The hurricane, the tide, the weight of the ship, and the necessity for keeping her foretopsail aback to drift into deep water, worked so much upon the submarine line that, after holding her for some length of time, the cable giving way, she instantly swung round before the wind, and was careering forward with increased velocity, when she was suddenly brought up, head to wind again, by the Calias cable. The barque was held, in spite of the heavy sea, the gale, and the pressure of the wind on her sails, for about an hour, when once more she broke away, and sailed off down the Channel. Both submarine lines unfortunately became unworkable in consequence of this untoward accident; and communication with the continent was partially stopped. The sea at the point where the vessel caught the cables is about 14 fathoms deep only, and the spot is within three-quarters of a mile from the shore. The company have already made arrangements to repair the cables the moment the weather will permit; and, meantime, messages are being telegraphed to Dover, sent thence by the steamer, which leaves thrice daily, to Calais, and are from Calias telegraphed to their various destinations. It is supposed that, the weather proving favorable, both cables might be completely repared in the course of a day.—*Times.*

* From the Lond. Chem. Gaz., No. 335.

† From the Lond. Artizan, Feb., 1857.

Electric Conducting Powers of the Metals of the Alkalies and Alkaline Earths.

Dr. A. Matthiessen has made, under the direction of Prof. Kirchhoff of Heidelberg, a series of experiments on this subject, the method of performing which, is fully described in the *London, Edinburgh and Dublin Philosophical Magazine*, for February. The following are the results. The temperatures are in centigrade degrees.

The conducting power of silver at 0° being = 100.

That of Sodium	at 21·°7	=	37·43
Magnesium	17·	=	25·47
Calcium	16·8	=	22·14
Potassium	20·4	=	20·85
Lithium	20·	=	19·00
Strontium	20·	=	6·71

The potassium and sodium used, were commercial; the others were obtained electrotypically. Experiments were also made, and are reported in the original paper, on the variation of the condncting power by heat.

In these results an interesting fact was observable, viz: that at some distance from the point of fusion, as well in the liquid as in the solid state, the decrements in the conducting power with the increase of temperature were almost in proportion, but near the point of fusion the decrease in the conducting power became much more rapid; with sodium this change appears to be very sudden, whereas with potassium it seems gradual. This difference in these metals corresponds with their different behavor in fusion; namely, potassium does not become suddenly liquid like sodium, but first passes through a semi-fluid state.

FRANKLIN INSTITUTE.

Proceedings of the Stated Monthly Meeting, March 19th, 1857.

John Agnew, Vice President, in the chair.

B. Howard Rand, Recording Secretary, P. T.

A letter was read from the Virginia and Tennessee Railroad Co.

Donations to the Library were received from the Astronomical Society of London, and Charles Wye Williams, Esq., London; L. A. H. Latour, Esq., Montreal, Canada; Hon. James Dixon, U. S. Senate; Hon. Job R. Tyson, U. S. Congress; Lieut. I. M. Gillis and Prof. A. D. Bache, Washington City, D. C.; University of Michigan, Ann Arbor, Michigan; Mercantile Library Association, St. Louis, Missouri; Young Men's Mercantile Library Association, Cincinnati, Ohio; The Virginia and Tennessee Railroad Co., Lynchburgh, Va.; The Maryland Institute, Baltimore, Md.; Robert C. Walker, Esq., Harrisburgh, Penna.; and Messrs. T. Y. Medlin, James D. Rice, Prof. J. F. Frazer, Trustees of the Philadelphia Gas Works, and the Mine Hill and Schuylkill Haven Railroad Co., Phila.

The Periodicals received in exchange for the Journal of the Institute, were laid on the table.

The Treasurer's statement of the receipts and payments for the month of February was read.

The Board of Managers and Standing Committees reported their minutes.

The Actuary reported that the following Standing Committees for the present year, have organized by electing their Chairmen and appointing the times for holding their stated meetings.

Committees.	*Chairmen.*	*Meetings.*
On the Library,	James T. Lukens,	1st Tuesday Evening.
" Exhibitions,	John E. Addicks,	1st Thursday "
" Arts & Manufactures,	James C. Booth,	1st Friday "
" Meteorology,	Alfred L. Kennedy,	2d Monday "
" Science and the Arts,	John C. Cresson,	2d Thursday "
" Meetings,	Washington Jones,	Monday previous to 3d Thursday.

Candidates for membership in the Institute (4) were proposed, and the candidates proposed at the last meeting (4) were duly elected.

Mr. F. Peale exhibited samples of a new valve for which Letters Patent of the U. S. had been granted to him, and explained its construction and form, being an imitation as nearly as possible by human hands of the valves of the arteries and veins of the system.

He stated what he believed were the advantages possessed by these valves, and although applicable to any purpose to which ordinary valves are applied, they are particularly so to elastic and flexible tubes, in which form they were presented to the attention of members of the Institute, and showed that they occupied no more space than the diameter of the tubes in which they were placed, were extremely simple and easy of construction, and therefore economical; that they were not liable to derangement; would bear the roughest treatment, which was exemplified by beating, bending, and even treading upon them, and would work equally well in any position. He also stated, that being made of the same material as the tubes themselves, that is, vulcanized gum elastic, they could not be injured by any agent that would not destroy that material, and finally exhibited the action of the valves in syringes, in a very satisfactory manner.

Mr. Jones submitted the plan of joining the ends of leather belts by means of hooks which was discussed, and samples of the hooks shown. They are made of cast iron wire flattened between rollers, and cut to lengths, when the ends are turned over towards each other. In this state they resemble links of a chain, having the straight part of one side cut away.

When a belt is to be joined, holes are punched at proper distances from the ends, the hooks inserted, and then closed by a blow from a hammer. The plan is a simplification of lacing or joining by wire, and seems to be superior, as the joinings can be made in less time and with less material. When the belt needs shortening the hooks must be cut, and cannot be used again, but the loss is small, as they can be supplied very cheaply.